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THE BOUTON OBSERVATORY

By T. C. H. BOUTON.

To many who are familiar with Florida, its mild and even climate and its remarkably clear skies, especially through the winter months when night after night the stars shine as steady points of brilliant light, it is a matter of wonder that so little advantage has yet been taken of the splendid conditions for telescopic work. No large observatory has been established in this state. A few small telescopes may be found in schools and colleges and in the hands of amateurs, but they are rarely used with systematic purpose. A notable exception exists at Miami, where the out-of-door Southern Cross Observatory, established by the late Mr. S. L. Rhorer, of Atlanta, Georgia, and equipped with seven 5-inch refracting telescopes, attracts and interests and instructs thousands of people from the opening of the year to the close of the tourist season.

To awaken public interest in the field of astronomy and to furnish opportunity for those who wish to see and learn is a most praiseworthy object. In St. Petersburg, the Bouton Observatory cordially welcomes all who are interested to look into the heavens by the aid of its modest equipment. Its telescope, however, is especially employed in the observation of variable stars.

St. Petersburg has well earned its name of "Sunshine City"; with equal fitness it might be termed "Starlight City," for from November to May but few locations could be found more favorable for work in the field of variables. The steady atmosphere, free from smoke and fogs and the disturbances created by rapidly changing temperature, enables the observer to operate with any good telescope below the generally accepted limit assigned to its aperture.

At the request of POPULAR ASTRONOMY, and especially for the amateur members of the A.A.V.S.O., the following description of this small but practical observatory is given.

Not being in one of the states where a certain scientific theory meets with marked disapproval, one may be permitted to say that this observatory is an evolutionary result. The owner's interest in astronomy was awakened when the Class of 1881 in Dartmouth College had the privilege of instruction under that prince of teachers, the late Professor Charles A. Young. Five years later it was aroused anew by the reading

of the then wholly scientifically out-of-date, but thought-inspiring work, "The Practical Astronomer," by Thomas Dick. The desire to see celestial objects became strong. A 1¼-inch spyglass was turned on the moon and Jupiter. This was followed by one of 1⅞-inch; then by a poor 4¼-inch; this by a far more effective 3½-inch. That was followed by a Lohmann 5-inch; then a Clark 6-inch, this objective being the last one entirely wrought by the senior Alvan Clark, and one of the very best of that aperture which ever came from the hands of that famous maker. Mr. Clark told the purchaser that he believed that it was, on the whole, the most perfect that he had ever made. The late Carl

FIGURE 1.

THE BOUTON OBSERVATORY, ST. PETERSBURG, FLORIDA.

Lundin, who tested it twenty years ago, pronounced it one of Clark's very best. It is now, we believe, in the observatory of Mr. C. W. Elmer. The end of this telescopic series is a 7-inch, the objective of which is the last completed by the late Mr. J. B. McDowell, of the Brashear Co. The evolutionary aspect of the series lies, not chiefly in succession, but in the fact that, much of the equipment being home-made, some

parts and accessories of one instrument have run into its successor. The writer's experience proves that an amateur, possessing only ordinary skill and tools, can construct a large part of his equipment. Excepting the achromatic objective, he can make lenses and eyepieces, build his tube and construct in whole or part his mounting, even to slow motion and circles.

The observatory building has two stories, is 14 feet square, and is strongly held upon a cement foundation by bolts set in the cement and passing through the sills. The cement base also forms the floor of the lower story, which is utilized as a room for storage and as a workshop where lenses, eyepieces, and various articles can be made. The height of this room is 7 feet 6 inches. Rising from the center is the cement pillar, 3 ft. by 3 ft. at the base, and tapering to a foot square at the top, the height being 10½ feet. Into this pillar, and extending 3 feet above the top, is set a 4½-inch heavy iron tube surmounted with an iron head upon which the mounting rests. The pillar at no point touches the floor of the observing room.

The sides of the building are of cement stucco, 1 inch thick, and laid upon a wooden frame. The roof, patterned after that designed and used by the late Reverend Joel Metcalf, divides at the middle, each section resting upon four ball-bearing trucks which run upon iron tracks fastened upon the upper sills. These sills extend seven feet beyond the north and south ends of the building, and are strongly braced both vertically and laterally. As the height of the roof is only 29 inches from ridge pole to base, only a small area above the horizon, at the north and south, is hidden from the telescope.

When closed, the observatory is rain-proof because of a raised projection upon one section over-lapping the other six inches. This movable roof when closed is securely fastened to the sills by strong iron hooks. The braces of the roof are six inches above the telescope tube when it points horizontally north and south. So easily is it opened or closed and made secure that the time required is less than two minutes. The writer believes that a roof of this design is more easily operated than any form of hinged or balanced roof, and less likely to get out of order.

The advantages of this style of observatory for housing a small telescope make a strong appeal to the amateur, and especially to the observer of variable stars. The cost of construction is not excessive, especially where only one story is desired. The present observatory is the fourth which the writer has had built. The first was 12 ft. by 12 ft., having sides of matched boards, and the roof running on ordinary trucks and tracks designed for doors. It cost in 1904, for building, foundation, and pillar only one hundred dollars. Used for sixteen years, it required no repairs, and it could be opened and closed when heavily weighted with snow.

The square observing room offers in its corners convenient space for desks and chairs, without their interfering with the moving of the ob-

serving-chair or the shifting of the telescope from object to object. The fully-opened roof gives all the advantages of an unobstructed sky-view, —a matter most desirable where the astronomer would show to others the constellations or the positions of objects viewed by the telescope. With no dome to revolve or shutters to adjust, the setting of the instrument on a new object is much facilitated, and time is saved. Not least among the advantages is the increased gain in definition arising from the rapid adjustment of the telescope to changing temperature. Under a dome this adjustment is necessarily slow. Then, too, the open roof avoids the drafts and currents of air which a dome can hardly escape. The disadvantages of the opened roof consist in the exposure to gusts and winds which may produce vibration of the telescope, and in the

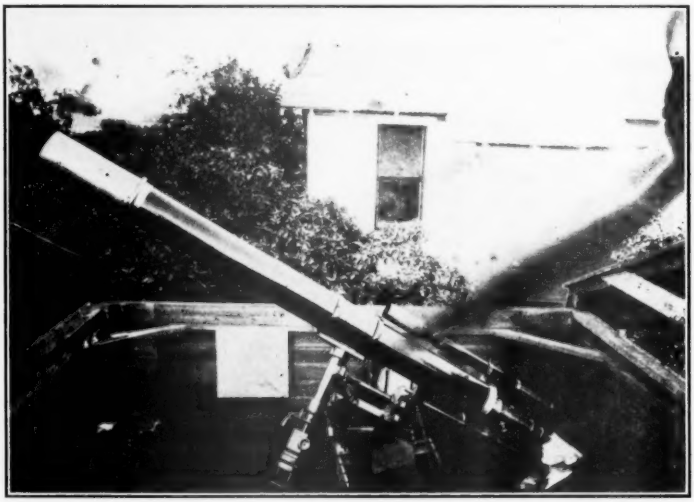

FIGURE 2.
THE 7-INCH TELESCOPE OF THE BOUTON OBSERVATORY IN AN EARLIER BUILDING.

likelihood of moisture gathering upon the objective. The use of a dew-cap, about 2½ times the diameter of the objective and lined with blotting paper, will nearly always prevent the latter difficulty.

The 7-inch objective of the telescope has a focal length of 98 inches, and is constructed after the form adopted by the late Dr. John A. Brashear, the flint disk being at the front. The definition of this objective is equal to that of the 6-inch Clark, above mentioned, and the light-grasp is relatively greater. Its high excellence is revealed in its separation of close doubles, and especially in its performance when turned on faint stars. Under favorable conditions it will show stars as faint as 14^{M}, as listed on the H.C.O. charts. In a few instances the writer has been able to glimpse stars charted as $14^{M}.5$. He has, however, suspected

that these stars and some others have been charted too low. Under ordinary observing conditions it is not difficult to work with this telescope to $13^{M}.6$ or $13^{M}.7$.

The tube is of rolled steel, mounted with heavy brass head-piece and rack and pinion tail-piece. A 2½-inch telescope, by Mogey, mounted upon it, answers at once for a finder and for the estimation of the magnitudes of variables brighter than $9^{M}.5$. One can work to the eleventh magnitude with this instrument, but below magnitude 10 a larger telescope is to be preferred. Above magnitude 9 one can work more rapidly and generally with more accurate results than those obtained with the larger instrument The optical accessories of the telescope consist of star and sun diagonals, sun-glasses, and a battery of 23 eyepieces. This wholly unnecessary number results from the writer's desire to experiment in lens-grinding and the making of various forms of oculars. Having a small foot-power lathe, nearly forty years ago he made attachments and tools for lens-working, and he has found great interest and pleasure in giving to it some of his leisure hours. After testing various forms of oculars, the conclusion is reached that for practical results either the standard Huyghenian or the Ramsden eyepiece is all that is needed. Another conclusion is that *the faintest stars are seen when an eyepiece having a three-quarter-inch focus is employed.* With such an ocular, the proportion of light to magnification is best. Any power which is much higher or lower will not disclose so faint a star. This has been found to hold true with any telescope the writer has used. The observer of variables, however, should always possess an ocular of 1¼-inch or 1½-inch focus and giving a wide field, for use when stars are bright.

The equatorial, made by the Clarks for the 6-inch, and heavy enough to carry an 8-inch, had neither circles nor slow motions. It had not been used for ten years and its bearings were supposed to be corroded, as the parts could not be moved. No price was put upon it. This mounting, which cost the writer nothing, he thoroughly soaked in kerosene until it could be taken apart and cleaned. Dried oil had caused the entire difficulty, and today the perfectly turned and polished bearings carry the telescope with unexcelled smoothness. To this old, simple equatorial the writer added clamps, screws for all needed adjustments, slow-motion in R.A. by means of endless screw working upon an arc, and 7-inch circles of brass plate having divisions which are read by microscopes to the fifth of a degree, giving an accuracy sufficient for locating any celestial object when medium powers are used. These additions were almost wholly hand-made with the aid of a few simple tools.

Undoubtedly, there are many discarded equatorials which could be purchased at slight cost, and which ingenious amateurs could work over and improve until they would meet their needs as well as modern and costly ones.

Every amateur's observatory should have a convenient and comfortable observing-chair. The one designed and made by the writer, (and

shown in Figure 3), fully meets the requirement. It consists of a strongly-built set of steps, upon which there is an adjustable seat. In this arrangement are six steps twelve inches deep, the vertical height being four and a half feet, and the width 27 inches. The set is mounted on ball-bearing casters, permitting it to be easily rolled to any position. When the seat is not on, these steps answer all the purposes of a

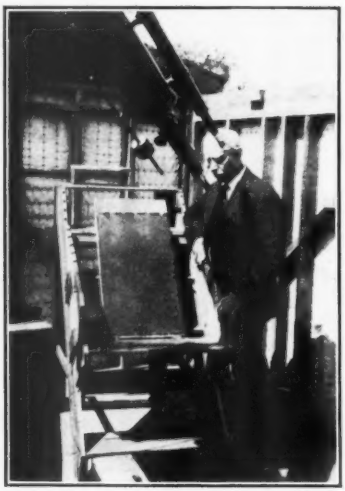

FIGURE 3.
MR. BOUTON AND OBSERVING CHAIR.

step-ladder. The sides extend slightly beyond the edges of the steps, thus forming a track upon which the seat slides.

Holes in these edges, 2¼ inches apart, receive iron pins set in the frame-work of the seat for the purpose of holding it at any desired height. The seat is provided with a hinged back, so arranged as to be held at any needed angle. This seat can be lifted off the steps or set upon them, and all adjustments made, in a few seconds.

There is one other adjunct to this observatory, the value of which to the observer of variables can hardly be over emphasized; it is the simply constructed lantern for holding the blue-print star charts now furnished the members of the A.A.V.S.O. The writer has long used lanterns of this design and finds them more satisfactory than anything else for reading the charts. Electric lights and flash lights dim the sensitiveness of the eye; but this small rectangular lantern of wood, which can be made in about an hour, and at a cost not exceeding fifty cents, avoids this, and it has other marked advantages.

The lantern in this observatory has a base 11½ inches square, and a height of 13½ inches. A door at the back admits the smallest size

brass, kerosene lamp. In the face of the lantern is an opening, 9 inches by 9 inches and covered with window glass. In front of this is a frame, circular on the outer edge, so as to revolve in a groove. A rectangular opening in the frame receives the blue print. On the inside of the lantern, the wood at the top is protected by tin from the heat of the lamp. At the back and base and at the top are small holes for the circulation of air and escape of gases. A curtain is arranged to fall over the glass so as to exclude all light, if desired.

When in use the lantern is placed on a stand close to the observer, the light is adjusted to just the degree necessary to show clearly the stars and numbers, and the chart is turned to correspond with the telescopic field. The observer's hands are entirely free to work the instrument, and by removing the chart there is all the light needed for recording. When working on faintest stars, the observer should never use the observing eye either for recording or for glancing at the blue print. That eye should constantly be kept at the extreme of sensitiveness. The chart-lantern can not be used for the reading of circles. In this observatory that is done by the aid of an old-style bulls-eye lantern which gives a very soft light.

The writer hopes that, if the description of his outfit offers no other suggestions, it may lead members of the A.A.V.S.O. to profit by the advantages of a chart-lantern. Once tried, it will not be cast aside.

St. Petersburg, Florida.

THE NAVIGATION OF SPACE IN EARLY SPECULATION AND IN MODERN RESEARCH

By NOEL DEISCH.

It is a curious fact that the Greeks never in any of their exuberant flights of fancy attempted a voyage to the moon. They had, of course, from the earliest ages formed a luminous picture of the hypothesis of the plurality of worlds. Orpheus alluded to the conception at a very early date, and it was definitively set forward in the sixth century B.C. by Pythagoras, who, as is well known, taught that the earth is a sphere like the sun and moon, that it rests without support in space, and that the moon is an inhabited world like our own. Anaximander, Anaximenes, Xenophanes, Leucippus, Anaxagoras, Democritus, Metrodorus, and a number of other Hellenic philosophers also cherished the idea of an extra-mundane life,—an idea peculiarly congenial to the Greek fancy, it would appear, as being exceptionally well fitted to give abundant range for the more speculative efforts of the imagination.

Yet the fact remains that in spite of all this fertile preparation none of the older generation of Greeks marshaled the enterprise to venture a voyage to the worlds overhead. It was left to Lucian of Samosata,

Syria, recognized as the foremost of the second-century sophists, first to take that heroic flight and to establish himself as the Columbus of all lunar discoverers. Lucian in fact broke ground with two tales of adventure among the stars,—*Icaromenippus* and his famous *True Story* (Αληθοῦς ιστοριας). The latter is much the more interesting of the two tales, and in fact takes rank as one of the most spirited stories of exploration in space that have ever appeared.

The *True Story* relates how Lucian and his party ventured out in a staunch and well-equipped vessel into the gloomy expanse of water that stretched outward from the Pillars of Hercules. On this forlorn sea, for a space of seventy-nine days, he was driven westward by a furious and unabating gale, when at last the entire expedition was hurled up into the sky on a gigantic waterspout. "But when our boat was hung up aloft," says Lucian, "a wind struck her sails and drove her ahead with bellying canvas. For seven days and seven nights we sailed the air, and on the eighth day we saw a great country in it, resembling an island, bright and round and shining with a great light. Running in there and anchoring, we went ashore, and on investigating found that the land was inhabited and cultivated." All hands agreed that this land could be none other than the moon. "We also saw another country below, with cities in it and rivers and seas and forests and mountains. This we judged to be our own world."[1]

Lucian and his companions met with all manner of thrilling adventure on this strange island that was the moon. Still keen for exploration, they struck out even farther into the ocean of space, visiting the sun, several of the constellations, the antipodes, and other regions that had long been familiar in mythology or conspicuous as subjects of poetical or philosophical speculation. At length, having roved all the expanse of the heavens, they trimmed their sails for the Hellespont.

After the publication of Lucian's story the theme rested for thirteen hundred years without attracting a single author of any notice. All of Europe was afire with the spirit of adventure (Columbus having but recently discovered the new world) when Ariosto gave free wing to his fancy and visited Cynthia's orb anew. With a due regard to congruities the lofty poet accepted St. John as his guide in the precarious business of scaling the heavens. Fontenelle suggests that it may have been by way of compensation for this somewhat risky poetic license that Ariosto dedicated his work, *l'Orlando Furioso,* to Cardinal Ippolito d'Este.

The whole question of the plurality of worlds was being actively debated about this time by astronomers and by theologians, most ingenious and often most vehement arguments attacking or defending it being set up on exceedingly precarious foundations by some of the cleverest thinkers of the age. The slender line which divides such license in

[1] The above passages are from the racy translation of the *True Story* by A. M. Harmon of Princeton University.

speculation from acknowledged flights of fancy was overstepped by the great astronomer Kepler in a story of an actual visit to our satellite which he was frank enough to style a Dream.[2] This book, however, was not published until death had safely placed its author beyond the reach of vexatious criticism.

Duracoto, the hero of the story, is presented to us as an Icelander of adventurous bent who, while engaged in explorations in the vicinity of the North Pole, had the fortune to discover a road that led him directly to the moon. The narrative abounds with anecdotes of hardship and preternatural exertion: Kepler seems to have felt that any person who aspired to such lofty achievements should act out the maxim, *ad astra per aspera.* Considered as a story the Dream will hardly bear comparison with other productions in this field, in great part being simply a weary exposition of certain astronomical theories and preconceptions of the author, who used the device of a visit to the moon merely as the most ready means of giving descriptions of the conditions that prevail there, as he imagined them to be.

In point of exuberance of narrative, very little criticism can be made of another voyage that appeared only eight years later, bearing the jaunty title *The Man in the Moon.* Its author, Francis Godwin, was an Englishman, but the hero, Domingo Gonzales, was a Spaniard by birth, by birth also a gentleman, and by inclination an adventurer,—a proclivity to which he owed the misfortune of having become marooned on the island of St. Helena. Life there became tedious business, and since no prospect of an early escape presented itself, the castaway settled himself to while away the time as best he might. There were swans living on the island in great numbers, and these he tamed and domesticated. As a final triumph of patience and skill he succeeded in training the powerful birds to carry parcels from place to place on the wing. The feat set Domingo's fertile mind into a ferment. If these swans can carry small parcels, he reflected, why may they not, in fact, be harnessed together in such a way as to carry a burden of some consequence? That burden was of course Domingo himself, and when his harness was completed he was delighted to find that he had at his command a flying equipage to do credit to his mettle.

One day while our hero was out taking the air in his phaeton his team of birds "ran away." The sober-headed Spaniard decided he had as well lean back and see where they would land. However, the swans showed not the least inclination to land at all; they were bent only on vaulting up into the sky, and as time went on it was brought home to Gonzales that he had left St. Helena and the earth for good. Meanwhile the moon grew larger and larger, and, to be brief, Gonzales landed there after twelve days of travel.

It may be of interest to naturalists to know that these swans were not

[2] *Mathematici olim Imperatorii Somnium, seu opus posthumum de Astronomia lunari.* Frankfort, 1634.

indigenous to the earth at all, but rather were denizens of the moon, and merely paid our planet a casual visit in their yearly migrations. This point was a fortunate one for Gonzales, for it enabled him to take his place in the seat of his phaeton the following spring, after a season filled with extravagant adventure, and make his way back to earth.

Another work bearing on ethereal travel that appeared in England about this time is unique in being the only sincere attempt at a study of the problem of navigating space undertaken until very recent years, or at least the only one which its author succeeded in having set to print. It is a treatise in two books, entitled *A Discourse Concerning a New World and Another Planet,* and first appeared in 1638, though the part most directly relating to the present subject was added only at the third impression, issued in 1640. John Wilkins, one of the founders of the Royal Society, was its author. Wilkins bore the title of Bishop of Chester, and was Warden of Wadham College, Oxford, and Master of Trinity College, Cambridge, during the most trying period of their development. In spite of this literary vagary he was really a scholarly man, and his varied experience, his wide fund of knowledge, and his ingenuity, all go to make his opinions of peculiar interest.

Unlike many another author who had touched on our subject, Wilkins was honest enough not to attempt to evade difficulties by circumlocution. He sets down at once fourteen *Propositions that are proved in this Discourse.* The first thirteen of these deal with the moon considered as a habitable heavenly body. The fourteenth, however, states boldly that "'Tis possible for some of our posterity to find out a conveyance to this other world, and if there be inhabitants there, to have commerce with them."

Our author had the modesty not to assert outright that he himself could construct such a conveyance; for that consummation his chief hope lay in the resources of the future, and he declares his belief that "time, who has always been the father of new truths, and has revealed unto us many things which our ancestors were ignorant of, will also manifest to our posterity that which we now desire, but cannot know. Time will come, when the endeavors of after ages shall bring such things to light as now lie in obscurity. Arts are not yet come to their solstice. But the industry of future times, assisted with the labors of their forefathers, may reach that height that we could not attain to. As we now wonder at the blindness of our ancestors, who were not able to discern such things as seem plain and obvious to us, so will our posterity admire our ignorance in as perspicuous matters."

After this encouraging foreword Wilkins took up some particular aspects of the outstanding problems concerned in his project, and did his best to show that the difficulties that block the way to their solution may not be insuperable. The want of correct knowledge concerning gravity (Newton was not yet born), magnetism, the height of the atmosphere, and other facts of nature whose explanation is now a commonplace to every schoolboy, was both a challenge and a spur to specu-

lation, and naturally led him into many grave errors. By long and involved argument he sought to show that there must be but little gravitative action at no great height above the earth, and that, if once that point of advantage could be attained, there would be but little further hindrance to progress toward our satellite.

But though the mere question of locomotion did not appear to oppose any insurmountable obstacles, several collateral matters seemed deserving of very careful consideration. Says he: "Though a man could constantly keep on his journey thither [toward the moon] by a straight line, though he could fly a thousand miles a day; yet he would not arrive thither under 180 days or half a year. And how were it possible for any to tarry so long without diet or sleep?" Wilkins grappled with these difficulties with a boldness worthy of his subject, nor did he permit a mere appearance of singularity in any proposal to debar it from impartial treatment at his hands. He took up the possibility of sleeping through the journey so as to do away with the necessity of eating, out-and-out fasting, using odors as a substitute for food, and deriving sustenance from no more substantial medium than the air itself. The advantages of each of these various proposals he examined in a scrupulously orthodox manner, bracing the most whimsical assertions with imposing Latin citations and references to classical or more or less contemporary authors. "I suppose there could be no trusting to that fancy of *Philo* the *Jew*" admits Wilkins "who thinks that the musick of the spheares should supply the strength of food," yet he appears rather inclined to defend the feasibility of eating air, pointing out that ". . . the chameleon is merely nourished by this [air]: and so are the birds of Paradise, treated by many; [here he gives references] which reside constantly in the air, nature not having bestowed upon them any legs, and therefore they are never seen upon the ground but being dead. If you ask, how they multiply? Tis answered, they lay their eggs on the backs of one another, upon which they sit til the young ones be fledg'd . . . Rondoletius, (*De Piscibus*, lib. 1, Cap. 13) from the history of Hermolaus Barbarus, tells us of a priest (of whom one of the Popes had the custody) that lived forty years upon meer air." In justice to Wilkins it must be stated that he also took up and discussed as a possibility, along with his other suggestions, the feasibility of taking along ordinary material food as a viaticum.

The matter of making provision for sleep rightly gave him little apprehension. "Again, seeing we do not then spend ourselves in any labor [because not working against gravity] we shall not, it may be, need the refreshment of sleep. But if we do, we cannot desire a softer bed than the air, where we may repose ourselves firmly and safely as in our chambers." For all this security, there appeared opening for discomforts incident to the coldness and rarity of the atmosphere in the regions that would have to be traversed.

On the whole Wilkins evidently thought that a trip to the moon, while a matter of no small difficulty, could likely be managed. He sug-

gested using wings, actuated by human power. He thought also that the great Madagascar *Ruck,* which the credible account of Marco Polo declared to be so immense that its wing-feathers were twelve feet long and so powerful that it could catch up an elephant like a hawk does a mouse, might be taught to carry a rider, and perhaps be persuaded to take him to the moon. "Or if neither of these ways will serve: yet I do seriously, and upon good grounds, affirm it possible to make a flying chariot," says he, and continues, "this engine may be contrived from the same principles by which Archytas made a wooden dove, and Regiomontanus a wooden eagle." . . . "I conceive it were no difficult matter (if a man had leisure) to show more particularly the means of composing it." The pressing nature of the Bishop's duties, it would appear, never gave him opportunity for the undertaking.

Wilkins anticipated that his work would present a very fair target for the wits of the time. For, as he observed, often have great men who advanced ingenious, practical, but daring theories been ridiculed by those "whose perverseness ties them to the contrary opinion," and "If these men were thus censured, I may justly then expect to be derided by most, and to be believed by few or none; especially since this opinion seems to carry in it so much of strangeness, and contradiction to the general consent of others. But, however, I am resolved that this shall not be any discouragement, since I know that it is not common opinion that can either add or detract from the truth. For,

1. Other truths have been formerly esteemed altogether as ridiculous as this can be.
2. Gross absurdities have been entertained by general opinion."

Wilkins' apprehensions were not altogether baseless. So well was the *Discourse* remembered that over a hundred years later it was parodied by Robert Paltock in the tale *Peter Wilkins' Journey to the Moon.* He was even absurdly accused of having plagiarized Godwin's story. One day the Duchess of Newcastle,—a clever and eccentric lady, the authoress of many "fancies" philosophical and poetical,—asked him where she might bait her horses if she undertook the journey. "Your grace could do no better," the Bishop replied, "than stop at one of your own castles in the air."[3]

So much for the sober findings of seventeenth century science when sitting in judgment on the question of the feasibility of realizing a journey to the moon. The same century proved quite prolific of fictitious assaults on our satellite. One of these, the *Voyage to the Moon* by Cyrano de Bergerac, which appeared some ten years after the publication of Wilkins' monograph, is of course quite well known to present-day readers.

Fearless explorer that he was, Cyrano little heeded the obstacles in-

[3] This anecdote is told by Wright-Henderson in his *Life and Times of John Wilkins,* London, 1910.

terposed by nature between himself and the land of his ambition. Questions of gravitation, air, sleep, food, and the other matters that caused Wilkins no end of concern perturbed him not at all; his formula for meeting them was action. "I lashed about myself a number of vials filled with dew," says he, "on which the sun darted his rays so vehemently that the heat, which attracted them as if they had been the largest clouds, raised me up so high that at last I found myself above the middle region."[4]

This was encouraging progress by way of a start, but since the dew-engine fell short of furnishing a fully satisfactory solution, de Bergerac cast about among various other expedients—he tried skyrockets without success—until finally he discovered quite accidentally that the moon exercises a powerful attraction on bone-marrow. He was then in a position to carry his project fully into effect.

While well enough in its way and for its original purpose as a conveyance to the moon, this means of locomotion could by no means be trusted for a more important journey that Cyrano had long been meditating, a trip, that is, to the very orb of day itself.[5]

It is but reasonable that for this expedition he should have devoted somewhat more care to the design of his equipment. The new apparatus consisted of a good, solid, wooden box, six feet high and three and a quarter wide, made very light and with all care to the joinery. Both bottom and top of this box were pierced by a neat hole. In the upper hole snugly fitted the neck of a crystal flask of icosahedral form, each facet of which was a concavo-convex lens.

The theory of operation of this contrivance, so far as can be had from the few elliptic phrases in Cyrano's work that touch on that important point, is about as follows: The sun's rays, concentrated in the interior of the flask by the many lenses that constitute its sides, create a vacuum within the flask. A violent inrush of air through the lower hole is thus induced, and it is this jet of air that bears the machine aloft.

It is plain that all the magic of the apparatus resided in the mysterious flask of many facets. This must have been a shattery affair, and in fact Cyrano records that in the course of his journey to the sun the glass icosahedron was accidentally broken. One is curious to know how the versatile explorer made repairs and succeeded in forging his way back to our planet. Unfortunately history is tantalizingly silent on the point, since before our author had completed his commentary on the States and Empires of the Sun he departed this world in earnest.

The Père Daniel, in a little book styled by him a *Voyage to the World*

[4] The "middle region" or *Aura Aetherea* was thought to be that indefinite region which supervenes upon the "air of meteors,"—this last being the earth's own atmosphere. Certain ancient speculators supposed it to consist of fire, but more general opinion held it to be a "pure, thin, rarified air, free from humidity, wind, rain, or cold."

[5] De Bergerac, Cyrano, *États et Empires du Soleil.* 1662.

of Cartesius[6] had recourse to a psychological method to overcome the barriers of space, which he asserts to have been communicated secretly by Descartes to a friend. It is notorious that the Cartesian philosopher was persuaded that, in this life at least, the human soul is fettered to the pineal gland. Father Daniel's method consisted in temporarily emancipating it by the action of a drug. In that virgin state of detachment, the soul, free from all encumbrance of the body, could pass through space without hindrance. The author gave exercise to this new faculty by paying a visit to the moon; in fact he skimmed out beyond the stars to distances only recently envisaged by Dr. Shapley, and there in the vastnesses of space watched gigantic forces at work, shaping worlds in accordance with Descartes' theory of vortices. Fifty years later the same theme was given adequate justice in verse by Père le Coëdic in a book bearing exactly the same title as that of Père Daniel. Both accounts would appear to have been anticipated in the story of Hermotimus, that prophet of old Ionia whose spirit, we are told, was wont to quit its clay and wander for lengthy periods through the universe in quest of the secrets of futurity.

We have seen that a man even of Kepler's genuine attainments did not disdain to direct his genius to the problem of flight in space. It is still more interesting to know that the noted Dutch mathematician, physicist, and astronomer Christianus Huyghens, inventor of the pendulum clock and discoverer of Saturn's rings, also considered it worthy of his attention. His work,[7] however, is devoted almost wholly to the question of the habitability of the stars and of the planets, as well as to the characteristics of the races that should be found on them, and gives but scant attention to the means of locomotion that might be chosen for the flight. Nevertheless his conclusions on this subject give evidence of some practical sagacity. Says he: "Since there's no hope of a Mercury to carry us such a journey, we shall e'en be contented with what's in our power: we shall suppose ourselves there." Huyghens will perhaps be gratefully remembered by some later investigators in these fields for his estimate of the true purpose and recompense of any study of the kind, to wit, that "in such noble and sublime studies as these, 'tis a glory to arrive at probability, and the search itself rewards the pains."

No doubt David Russen of London had in mind others of less lofty spirit than those sharing the sentiments of the noted author of Cosmotheoros when, in the preface of a little book published in 1703 he wrote: "The following Tract will find approbation from the Learned and the Ingenious, while those troubled with Moon-blind Intellects, like Dogs barking at the Moon, will carp at what I have written." In the event

[6] Daniel, Gabriel; *Voiage du monde de Descartes.* 1692. The English translation has the title *A Voyage to the World of Cartesius* and came out in 1694.

[7] The original work was written in Latin and bore the title Κοσμοθεωρος, *sive de terris coelestibus earumque ornatu conjecturae.* This appeared in 1698, but an English translation, *Cosmotheoros: or conjectures concerning the planetary worlds and their inhabitants* also came out later in the same year.

that a particularly callous reader should prove impervious to insinuation, Russen makes it clear that a discourse of this weight is not at all "calculated for those Blocks who are sick with the Stupidity of a lazy ignorance. It claims the Protection of more refined Genius's, whose thoughts soar above this Dunghill Earth, and read the Divine attributes in other Legible Characters besides what are imprinted on this TERRAQUEOUS GLOBE."

Russen has an altogether original suggestion to make by way of setting to rest the long mooted problem. It had better be stated in the author's own words. "Since Springiness is a cause of forcible motion; and a Spring will, when bended and let loose, extend its self to its length; could a Spring of well-tempered steel be framed, whose basis being fastened to the Earth, and on the other end placed a Frame or Seat, wherein a Man with other necessaries could abide in safety, this Spring being with Cords, Pullies, or other Engines bent, and then let loose by degrees by those who manage the Pullies, the other end would reach the Moon, where the Person who ascended landing, the Spring might again be bent, till the end touching the earth, should discharge the passenger again in safety." Really a comfortable issue, after such a harassing passage!

The Tale of the World of Mercury (*Rélation du Monde de Mercure*), published anonymously in 1750, contains some highly interesting descriptions of other worlds gleaned with the aid of a "philosophical" telescope. Two years later Voltaire gave out his *Micromégas,* whose hero had such an uncanny understanding of the laws of gravitation and of other forms of physical attraction, and a knack of applying it all to such good purpose, that—helped along sometimes merely by a ray of light, sometimes by a comet or a streamer of the aurora,—he contrived to flit from one celestial orb to another until he had traversed all the vast distance intervening between his original home on the star Sirius, and the planet Saturn. Arrived there, Micromégas had the luck to fall in with a companion worthy of his genius, and the two of them visited our own earth in company. They at first experienced no little difficulty in determining whether or not this paltry mud-ball might be the host of a race of living beings: "What makes me believe that nobody lives here" says the Saturnian "is that it appears to me that common-sense people wouldn't want to live here." "Well," ventures Micromégas, "perhaps the inhabitants are wanting in common sense." Conversation with the denizens of earth hardly dispelled this preconception, and when the visitors discovered that human affairs are not arranged as they are on Sirius or on Saturn they so far forgot their lofty origin as to descend to very sharp criticism of our institutions, thus revealing a failing known to be common among foreigners even at this day.

Incomparably the most sparkling and suggestive work touching on this subject that has ever appeared is Fontenelle's *Conversations on the*

Plurality of Worlds.[8] Though in it the author does not shed much light on the question as to whether we shall ever be able to build up a commerce with the men in the moon, what he does say in that direction is argued with such plausibility that he almost makes good his caution that he may constrain conviction against the reader's own better judgment.

The various imaginary voyages in space written by Swedenborg[9] and by Marie-Anne de Roumier,[10] as well as others which do not present any new suggestion as to means or appliances for traveling in space, nor indeed any particular evidence of originality, but rather represent the product of the operation of an extravagant fancy, need not detain us. However, several other tales written during the second quarter of the last century cannot be overlooked. One of these,[11] by Joseph Atterley, is remarkable as being the first book in which, so far as the writer has found, is set forth the conception of a substance which acts counter to gravity, which, in other words, has the property of being repelled by the earth instead of being attracted to it as it rightly should be, and which thus enables the hero of the story to escape from the earth into space. In this original case it is a metal which "when separated and purified, has as great a tendency to fly off from the earth as a piece of gold or lead has to approach it."

Among the many who have availed themselves of the diagravitational properties of the element in question, variously dubbed *lunarium, cavorite,* etc., should be mentioned Dr. J. L. Riddell, who in a curious story[12] that appeared in New Orleans about the middle of the last century somewhat modifies the original idea of Atterley, the metal being considered as acting as an impervious screen to gravity (much as more recently used by H. G. Wells in his book *The First Men in the Moon*), and thus conferring the property of negative weight on objects placed above it, rather than on itself. It is of interest to note that Riddell, even at this early date, suggests revitalizing the air entrapped in the machine by producing oxygen from potassium chlorate and absorbing carbon dioxide by means of lime.

One naturally wonders whether Edgar Allan Poe, who was so much given to daring flights of fancy, may ever have glanced over Atterley's novel. We have evidence in one of his criticisms that he had seen Godwin's story. The latter must have excited his curiosity, and perhaps his ambition. At any rate he is the author of what is unquestionably one of the cleverest excursions to the moon ever written. Poe paid his visit

[8] Fontenelle, Bernard de Bouvier de; *Entretiens sur la pluralité des mondes habités.* Paris, 1821.

[9] *Arcana Coelestia; De Telluribus in Mondo Nostro,* etc.

[10] *Voyages de milord Céton dans les sept planètes,* 7 vol., The Hague, 1765.

[11] Atterley, Joseph. *A Voyage to the Moon: with some Account of the Manners and Customs, Science and Philosophy of the People of Morosofia and other Lunarians,* New York, 1827.

[12] Riddell, J. L. *Orin Lindsay's Plan of Aerial Navigation; with a narrative of his Explorations in the Higher Regions of the Atmosphere, and his Wonderful Voyage Around the Moon,* New Orleans, 1847.

to our satellite through the columns of the *Southern Literary Messenger* in June, 1835, in a story that bears the title *The Unparalleled Adventures of one Hans Pfaall.*

It need hardly be said that the creator of Dupin was not at any loss for means to effect his expedition into the empyrean. As usual he based his results on plausible and logical, though not strictly conclusive, scientific reasoning. Hans Pfaall argued that since the air decreases in density at a constantly diminishing ratio, go as high as we may we cannot arrive at a limit beyond which no air is to be found; all space is permeated by a certain residuum of an atmosphere. This being so, the aeronaut would be assured of a supply of air at any height to which he might wish to climb. For the rest Pfaall relied on a balloon of unprecedented dimensions and filled with an inconceivably light gas to give him an upward velocity so prodigiously great that he would be carried to the point where the force of the earth's attraction would be equaled and superseded by that of the moon.

To overcome difficulties of respiration which would develop under the low barometric pressures existing at these great heights there was fitted to the balloon a large and strong canvas bag, which entirely enclosed the basket and extended up over the concentrating-hoop, being drawn together into an air-tight knot at its top to form a hermetic enclosure. This bag was rendered impermeable to air by means of rubber varnish, and fitted with small glass windows to permit observation. When Pfaall had reached a height such that the atmosphere became so attenuated that breathing was interfered with, he simply increased the pressure within the bag by forcing air into it by means of a hand-operated pneumatic pump. By experiment he found that the air required changing about every hour, and he admits that at the mid-point of his journey it required long and excessive labor to compress within the chamber sufficient air for the maintenance of life.

In *Hans Pfaall* Poe made free use of his powerful gift of lending plausibility to his narrative, but since the story is written largely in a tone of banter, it evidently was not, as has occasionally been affirmed, intended to deceive.

Deceit, however, was certainly the object of another account that began to appear in the columns of the New York *Sun* about three weeks after the publication of Poe's story, under the pretentious title: *Discoveries in the Moon Lately made at the Cape of Good Hope,* by Sir John Herschel, LL.D., F.R.S., etc. The story, whose author is commonly thought to be Richard Adams Locke, purports to be an account of marvelous discoveries in the moon, supposedly brought to light by a new and exceptionally powerful telescopic instrument conceived by Sir William Herschel and carried out to completion after that astronomer's death by Sir John Herschel, his son. According to the account the comparatively modest magnification of 6,000 was first realized, which brought the moon apparently to within forty miles of the observer; but subsequently the apparatus was greatly improved. By the expedient

of intensifying the feeble telescopic image by light thrown by an oblique mirror upon the "focal object of vision," joined with the light-gathering power of a speculum twenty-four feet in diameter, the most minute details of the lunar surface became observable. There were thus revealed exotic forests and flowers, strange animals, and especially a remarkable creature all covered with hair like a monkey and provided with an immense pair of bat-like wings, much as some artists have pictured Mephistopheles. All of these are described with a minute circumstantiality of detail well calculated to wile an incautious reader into the belief that the story was an authentic report of an extraordinary contribution to science.

The appearance of the "Moon Hoax," as it has since come to be called, immediately compelled attention, and it was read with unexampled avidity in America and in all parts of Europe. On the whole, one must admit that it was cleverly conceived and ably written, and represents what is undoubtedly the most audacious and the most successful piece of scientific trickery that has ever been perpetrated. Its success must have caused Poe some pique, for in a note appended to a later edition of *Hans Pfaall* he took elaborate pains to point out the inconsistencies of Locke's tale.

Shortly after the middle of the past century voyages began to spring from the press like mushrooms from the turf after a shower, and one of these, Jules Verne's classic tale *From the Earth to the Moon*[13] marks the high point of all lunar adventures. It is of course too well known to make necessary any extended review. Everybody has read of how Barbicaine and his friends took their place in a projectile which was shot from a monster cannon into space, where it pursued a parabolic orbit around the moon until deviated from its path by a meteor, and of how it at last fell back to earth.

Undiscouraged by Verne's achievement, a host of writers since his time have made their pilgrimage to Diana's orb. Camille Flammarion, in his *Contes Philosophiques; Lumen; Uranie;* etc., took occasion to make several such journeys, in all of which he seems to have favored a kind of telepathic flight, reminiscent of the *Itinerarium exstaticum* of Rev. Athanase Krischer, (Wurzburg, 1660). It is rather odd that the famous French romantic scientist should have adopted such an awkward device: surely anyone acquainted with the spirit of his work would hesitate to attribute this choice to any deficiency of imagination. Moreover, his acquaintance with the prior art in the field, as displayed in his book *Worlds: Real and Imaginary*[14] (to which interesting work the writer wishes here to acknowledge his obligation for a number of references to early "voyages") would have been expected to put him in line with some medium of travel possessed of a greater measure of scientific appeal. Simon Newcomb, following the example of Kepler and

[13] Verne, Jules. *De la Terre à la Lune*, Paris, 1865.

[14] Flammarion, Camille. *Les mondes imaginaires et les mondes réels,* Paris, 1865.

Huyghens, tried his hand at a novel, *His Wisdom, the Defender* (Harper, 1900), which, though not a voyage to another world, features a machine wholly fit to negotiate such a voyage. It is notorious that Newcomb, at the dawn of the aerial age, pertinaciously contended that we must look for a solution to the problem of aerial navigation, which then appeared almost as unpromising an undertaking as ethereal navigation does now, to come from some revolutionary discovery in physics rather than from an application of the materials and agencies of engineering then at hand. In an article in *McClure's* of September, 1901, he hinted that this new agency might be something in the way of an interaction between the ether and matter,—and *His Wisdom* represents a somewhat unfortunate attempt to develop the potentialities of this idea in fiction. Thanks to a new kind of matter closely enough related to ether to react with it, called *etherine,* and a new kind of energy, *therm,* somewhat akin to electricity, the hero of the story was able to make vehicles with which he could skim about in the regions above the earth's atmosphere at a prodigious velocity. Realizing the wonderful resources of power invested in him by his invention, and being of altruistic aims, he used it to force an international *coup d'etat* and succeeded in putting an end to war forever.

The present period in the development of etheronautics* will likely be put down by future historians of the subject as one marked by the initiation of serious investigation of the problem of flight in space by men of the highest competence, as also by a strong centering of interest about the rocket or reaction motor. Writers of fiction long ago discovered and exploited the possibilities of this agency. The heroes of both de Bergerac and Jules Verne used huge squibs in the subordinate rôle of assisting or guiding their vehicle in its flight, and in a story by Achille Eyraud entitled *Voyage à Vénus* published serially in 1865, the rocket, unassisted by any accessory device, was featured as the propelling agency of the ship. It has been so used by novelists many times subsequently, notably by Kurt von Lasswitz in *Auf zwei Planeten,* 1897, in which the discharge of the reactant is achieved through electrostatic repulsion. In a lunar romance published in the *Cosmopolitan* magazine late in 1916, under the title *The Moon Maker,* it is proposed to utilize the reaction generated by the emission of α and β particles from the element uranium, whose atomic decomposition is assumed to be enormously accelerated by the action of a peculiar radiation known only to its author, Mr. Arthur Train. It is significant that the story is announced as having been written in collaboration with Professor R. W. Wood of Johns Hopkins University. Other novels of this type are

*Esnault-Pelterie has introduced the term *astronautics* to designate the new art, but it may be a question whether this is as fitting a term as *etheronautics* (since we refer to the sea as being navigated, rather than the islands or the continents) $\alpha\iota\theta\eta\rho$ being of course understood here in its classic sense as signifying the region that extends beyond the earth's atmosphere, rather than the physical ether of the relativist.

those of K. E. Ziolkowski, *The Bounds of the Earth,* Kaluga, 1920, which features a reaction motor powered by liquid hydrogen and oxygen, and Bruno H. Burgel's *Der Stern von Afrika,* 1921, in which a kind of machine-gun reaction motor is used. Another recent novel by Miral-Viger, *L'Anneau de Feu,* Paris, 1922, uses substantially Train's idea, though the author, evidently deeming the existing radioactive elements altogether too feble for the purpose in hand, substitutes for them an imaginary one, *Virium,* whose activity is some 60,000 times greater than that of radium, and which moreover may be decomposed at will by the action of cathode rays,—though it conveniently escapes destruction by its own beta radiation!

Even as a subject of earnest speculation, the reaction motor may lay claim to a respectable history. Newton himself seems to have been the first to point out, in one of his lectures, that it would be possible by means of the rocket to travel in the vacuous reaches of outer space. Scherschevsky tells in a recent popular book on etheronautics[16] that Fedor Kibaltschitsch in 1882 proposed a plan to Tsar Alexander II (as lately uncovered from the secret archives by the Soviets) for the development of a planetary rocket. Hermann Ganswindt, a German "privatforscher," appears to have made some rather fanciful suggestions along the line of a planetary rocket-ship at a lecture delivered in Berlin in 1881, to which disclosure German writers attach considerable weight as proof of priority in this line of work. The Russian Ziolkowski is also declared to have begun his speculations in 1895, since which date he has from time to time published articles and books on this subject. Unfortunately no translation of his work *in extenso* has been published, and no really critical appreciation is available. The Peruvian chemical engineer Pedro E. Paulet in *El Commercio* of Lima, issue of October 7, 1927, gives some details of experiments with rocket apparatus using liquid explosives, which he declares he had performed in 1895. The Swedish astronomer and physicist Birkeland is also said to have conducted experiments during 1905-1907 with rockets powered with solid as with liquid propellants, and working in vacuum, but the results were not made public.

Not long before the war a well-known French aeronautic engineer, M. R. Esnault-Pelterie, read a paper on the subject of the reaction motor as applied to the navigation of space before the Physical Society of France. He made an estimate of the efficiency to be expected, and considered dynamite and radium as sources of energy. Unfortunately the complete paper was not published, and the abstract[17] omits the author's computations. Curiously, Dr. André Bing had actually made application in Belgium for a patent on a similar idea in 1911, and on hearing of Esnault-Pelterie's speculations claimed priority of conception on the basis of his patent.

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[16] Scherschevsky, A. B., *Die Rakete, für fahrt und flug,* Berlin, 1929, 134 pp.
[17] Soc. Franc. de Phys., *Proc. Verb.* (etc.), 1912, p. 90.

To Professor Robert H. Goddard of Clark University must go the credit of first having put the proposal of the reaction motor as applied to the navigation of space into good scientific form, applying to it exhaustive and rigorous mathematical treatment supplemented by carefully conducted experiments tending toward the design of a concrete apparatus,—specifically a rocket capable of reaching extreme altitudes in the atmosphere. The investigator's conception of "extreme altitudes" was sufficiently elastic to include the moon in their confines. This most interesting and valuable paper was printed by the Smithsonian Institution in its *Miscellaneous Collections*, Vol. 71, No. 2, 1919.*

Professor Goddard considers in detail the theoretical capabilities of rockets powered with various smokeless propellants, as also with hydrogen and oxygen, and derives the quantity of propellant required to lift a given mass to any height in the atmosphere, or to impart to it the escape velocity. The paper also includes a report of the experiments just alluded to, these having been performed in air and in vacuum with the object of determining the relation of various parameters to the velocities achieved by allowing gases released by the combustion of explosives to expand in a divergent nozzle; it touches also on various ancillary matters, such as the possibility of making a direct hit by a rocket on the moon visible by means of the flash produced by the combustion of a magnesium mixture, the probability of the collision of the rocket with meteoroids, and other questions.

A few years subsequent to the publication of Goddard's paper Hermann Oberth produced a work[18] which has deservedly attracted a great deal of attention, especially on the continent. Like Goddard, he bases his reasoning on the rigorous methods of theoretical mechanics. Oberth examines at length the capabilities of two types of rocket, both propelled by liquid fuels, one by alcohol and oxygen and the other by hydrogen and oxygen, and does not hesitate to give plans and descriptions of completely equipped apparatus. He likewise considers the physiological and psychological effects of high accelerations, problems of equilibrium, probability of collision with meteoroids, etc. Dr. Walter Hohmann some time later published a highly mathematical study[19] concerned especially with the evaluation of the quantities of energy required for negotiating a voyage to each of the several planets, and the methods that might be used in effecting a landing on various celestial bodies, more especially the earth. Esnault-Pelterie, continuing his earlier work, has

*As explained in a note printed in *Nature* (London), issue of Oct. 18, 1924, p. 574, Dr. Goddard's interest in this subject extends back to about 1899, and his first work to 1907.

[18] Oberth, Hermann, *Die Rakete zu den Planetenräumen*, Munich & Berlin, 1923, 92 pp. As we go to press the third edition of *Die Rakete*, which now bears the title *Wege zur Raumschiffahrt* comes to hand. This is a volume of 425 pages, with 159 figures and 4 folding plates.

[19] Hohmann, Walter, *Die Erreichbarkeit der Himmelskörper*, Munich, 1925, 88 pp.

also summarized his results in a thoroughly technical paper.[20] The popular expositions of Valier[21] and Ley[22] must not be overlooked, as having done much to arouse interest in the project among the public of Germany and Austria.

These references will not be understood as exhausting the literature of the subject. A bibliography compiled by Scherschevsky includes 23 titles of books and 55 titles of magazine articles. A respectable part of this material is in Russian; we are told in fact that Professor Rynin is at work on a twelve volume encyclopedic treatise on interplanetary travel, three volumes of which have appeared. There is even a magazine[23] devoted exclusively to rocket travel, which is now in its fourth year.

Nor must we forget the international Rep-Hirsch prize offered by the Société Astronomique de France for the best paper submitted in annual competition.[24] From newspaper reports we gather that Oberth, the first winner of this prize, has latterly secured backing for practical work. Goddard is also engaged in active experimentation. Altogether it would appear that the application of the reaction motor to the navigation of space is pressing very hard for a place as one of the accepted problems of mechanics; certainly it bears credentials from circles of the highest repute.

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AMERICAN ASTRONOMICAL SOCIETY.

ABSTRACTS OF PAPERS

(Continued from page 32.)

THE RECENT SUN-SPOT MAXIMUM AS DEDUCED FROM MEAN MONTHLY AREAS AT THE U. S. NAVAL OBSERVATORY.

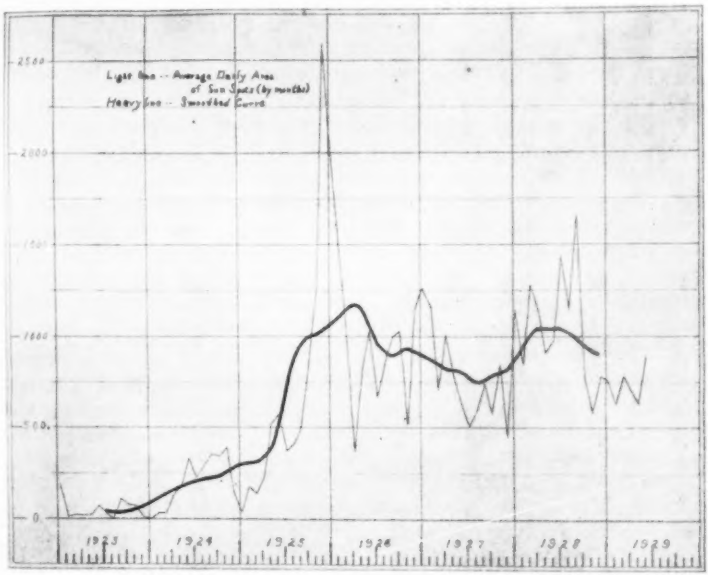
By G. H. Peters and N. E. Wagman.

The recent sun-spot maximum was unique in several particulars. The period of time covered was unusually long. The combined mean areas of spots or groups were moderate compared with former maxima.

The most notable feature was the occurrence of two peaks of greater activity separated by a period of about two years. The first was formed about the middle of April, 1926. This first peak developed somewhat abruptly and is shown in the graph with a fairly sharp summit.

[20] Esnault-Pelterie, R., *L'Exploration par fusées de la très haute atmosphère et la possibilité des voyages interplanétaires*, Paris, 1928, 96 pp.
[21] Valier, Max, *Raketenfahrt*, Munich & Berlin, 1928, 252 pp.
[22] Ley, Willy, *Die Möglichkeit der Weltraumfahrt*, Leipzig, 1928, 244 pp.
[23] *Die Rakete*, Breslau.
[24] Those interested in this prize may address the Comité d'Astronautique, Société Astronautique de France, 28 rue Serpente, Paris VIe.

The curve then shows a gradual decline in activity until August, 1927, when the second peak started to develop. It reached its maximum in the middle of 1928. At this latter peak the smoothed curve of the graph flattens out, showing a nearly constant average daily area from April to July, inclusive.



GRAPH OF SUN-SPOT ACTIVITY, U. S. NAVAL OBSERVATORY.

With minor fluctuations the curve then descends until the end of June, 1929. It is probable that solar activity is now diminishing, although toward the end of June many spots and groups, some of large size, were still in evidence. Soon a considerable decline in activity is to be expected.

The previous minimum was in August, 1923. Therefore, based on the typical sun-spot cycle of 11.1 years, a maximum should have occurred in 1927 or 1928. Considering this fact it is evident that a double maximum has taken place, with each summit of nearly the same magnitude.

Wolf's "sun spot numbers," derived by a slightly different formula, show these two peaks occupying similar positions in the time coördinate, but with the relative magnitudes interchanged.

Beginning January, 1927, sun-spot data have been published in the *Monthly Weather Review* by the Naval Observatory. Solar observations missed at the Naval Observatory on account of clouds have generally been supplied through the coöperation of the Harvard Astronomical Laboratory, the Yerkes and Mount Wilson observatories.

THE DOMINION ASTROPHYSICAL OBSERVATORY AND ITS WORK.

By J. S. Plaskett.

This paper gives a short historical sketch of the establishment of the observatory which was first brought formally before the Canadian Government by a resolution of the Society at its first Ottawa meeting in 1911. It recounts how these and other formal and informal efforts were finally successful in securing the awarding of contracts for the construction of a 72-inch reflecting telescope in October, 1913. The mounting was completed and erected in three years but the mirror was not finally completed and installed until the beginning of May, 1918. The first star spectrum obtained on May 6, 1918, has been followed by nearly 18,000 more in the eleven years since that date.

Following the completion, in somewhat over two years, of the first routine programme of the radial velocities of some 770 Boss Stars which resulted in the determination of 594 radial velocities and the discovery of some 180 spectroscopic binaries, the work has consisted entirely of individual researches by the members of the staff. These researches have been very varied but are all contained within the wide field offered by stellar spectroscopy. One consisted of a complete investigation of the motions and other properties of all the O-type stars within reach at Victoria and of all the B0 to B5 stars brighter than magnitude 7.5 and north of declination —11°. From these there has resulted a striking confirmation of a rotation of the galaxy, in which the matter in interstellar space, which is shown to be uniformly distributed, shares. Another investigation was the determination of the spectroscopic absolute magnitudes of 1105 F to M stars, which is being followed by that of about 1200 A stars of which both radial velocities and spectroscopic absolute magnitudes are approaching completion. The more purely astrophysical problems that have been successfully attacked embrace such diverse subjects as the determination of atomic constants from the spectra of O-type stars, the development of a new method—the wedge method—of stellar spectrophotometry with resulting colour temperatures of the sun and a number of stars, and the development of a well confirmed explanation of the physical nature of the peculiar spectral emission of the Wolf-Rayet stars.

In the course of these researches at Victoria in the past 11 years, the radial velocities of some 1900 stars, of which 923 have been published, have been determined; about 400 spectroscopic binaries, of which 245 have been published, have been discovered; and the orbits of 106 spectroscopic binaries, of which 87 have been published, have been determined.

THE GALACTIC ROTATION AND THE K TERM FOR O- AND B-TYPE STARS.

By J. S. Plaskett and J. A. Pearce.

An analysis of the radial velocities of 870 O to B5 stars shows that the hypothesis of a galactic rotation around a very distant centre at

galactic longitude 326° is strongly confirmed. The rotational effect appears most certainly for the O to B2 stars, and for the fainter B3 to B5 stars. It is also probably present in the brighter groups but is masked by marked group motions especially in the southern Milky Way and in Orion, where there are high velocities of recession. If these group motions are allowed for, the rotational effect would be present in all groups and the irregularities be largely removed.

The K term for the O and B stars is no longer even approximately a constant, as had been supposed, but practically vanishes for all B stars fainter than $5^{M}.5$ or $6^{M}.0$. While there may be a small positive increment due to the Einstein red shift or to erroneous wave-lengths in earlier work, the K term is due practically entirely to preponderatingly positive group motions in several regions of the sky. The high values in the brighter B's is undoubtedly due to the large recessional motions of the nearer stars, between galactic longitudes 240° and 300°. The O stars seem distinct from the B's, in that the K term remains strongly positive even for the fainter stars and there is evidence, in addition to the rotational effect, of a decided expansion of the system of O stars.

The average residual velocities of the B-type stars is higher than expected, ranging from 9 km/sec for the B3 to B5 stars, to 11 km/sec for the B0 to B2 stars, and to 17 km/sec for the O's. There is also strong evidence that it increases considerably as the stars become fainter and hence more distant.

THE MOTIONS OF INTERSTELLAR CALCIUM.

By J. S. Plaskett and J. A. Pearce.

The principal results of this investigation are as follows:

1. A catalogue of 261 stars of spectral type O5 to B3 with well determined stellar and interstellar calcium velocities was compiled.

2. A general solution for the solar motion, galactic rotation, and K term from the calcium velocities gave a solar motion of 19.9 km/sec towards an apex in longitude 26° and latitude +4° (galactic), about 20° distant from the usually adopted apex. The distribution of the stars in longitude 340° to 200°, latitude —20° to +20°, was decidedly unfavorable for a determination of the solar apex. The rotational term of +7.3 km corresponds to a mean distance of over 430 parsecs, while the galactic centre is in longitude 335°, some 10° from the accepted position. The K term for the interstellar calcium is zero.

3. A second solution, assuming the usual solar apex, gave a rotational term of +7.9 km/sec (480 parsecs) and a galactic centre in longitude 332°, the latter agreeing within the error of determination with the centre found from the motions of the B-type stars. The K term is again zero.

4. The uniform distribution of the interstellar calcium was tested by dividing the stars into five magnitude groups and solving for a K term and galactic rotation, assuming a solar motion and galactic centre. With the exception of the brightest group, too near to give a pronounced

effect, the rotational term for the calcium clouds was exactly one-half that for the stars, as should result on the basis of uniform distribution.

5. A representation of the observations of the 19 regions concerned strikingly shows that the observed velocities result from a solar motion combined with a galactic rotation. The investigation establishes the fact that the interstellar calcium is not only uniformly distributed through space, but partakes of the general galactic rotation.

A STUDY OF THE SPECTRUM AND ORBIT OF UPSILON SAGITTARII.

By Frances L. Seydel.

A set of orbital elements, corrected by least squares solutions in five unknowns, and a velocity curve were derived from Ann Arbor observations made during the years 1921 to 1926. A new period of 137.9567 days was determined.

A final set of orbital elements, corrected by a least squares solution in six unknowns, and a velocity curve were derived from the combination of the Victoria and Ann Arbor observations. The final elements are:

$P = 137.9567$ days; $\mu = 2^\circ.6095$; $T = -4.73 \pm 0.07$ days; $e = +0.060 \pm 0.016$; $\omega = +16^\circ.8 \pm 9^\circ.5$; $K = +49.12 \pm 0.78$ km; γ (Seydel) $= +13.29$ km; γ (Plaskett) $= +8.21$ km; $a \sin i = 90{,}341{,}000$ km; $m_1^3 \sin^3 i/(m + m_1) = 1.677 \odot$.

The velocities based on the helium lines alone were compared with the final curve based on all measured lines and were found to conform closely to the curve.

The fine structure of the hydrogen lines was investigated. Six components were found to lie on each side of the central absorption of Hβ. Hγ, Hδ, Hϵ, and Hζ at mean velocity displacements of -476, -380, -302, -204, -150, -92, $+97$, $+156$, $+209$, $+303$, $+380$, and $+475$ km. All twelve components partake of the regular orbital shift of the central absorption of the hydrogen lines.

Intensity variations were found in the emission and absorption in the hydrogen lines. Two out of three observed maxima occurred in emission and absorption at approximately the same orbital phases. The maxima of emission intensity for the five Balmer lines occurred near phases 45, 90, and 106 days, while the maxima of absorption intensity occurred near phases 45, 60, and 92 days, referred to Wilson's initial epoch of J.D. 2,419,648.72 days.

NEW DETERMINATION OF THE CURVATURE RADIUS OF SPACE.

By Ludwik Silberstein.

The author derives for the resultant velocity v of a star in de Sitter's space-time of curvature radius R the approximate formula

$$v^2 = v_0^2 + \frac{c^2}{R^2}(r^2 - r_0^2) = v_0^2 + \frac{c^2 s^2}{R^2},$$

where c is the light velocity, r the actual distance of the star, and r_0, v_0 the distance of and the velocity of passage through, the perihelion. If v_r be the radial (spectroscopic) velocity, the distance s of the star from its perihelion is determined by $s = rv_r/v$. For two groups of stars (1 and 2), one more near and the other more distant, the mean $\overline{v_0^2}$ can be reasonably assumed to have the same value. This leads to

$$R^2 = c^2 (\overline{s_1^2} - \overline{s_2^2}) / (\overline{v_1^2} - \overline{v_2^2}).$$

Thus, if the distances of the stars, their radial velocities, and proper motions, and therefore also v and s are known, the radius R can be determined.

This formula is first applied to 24 Cepheid variables. The data are taken from Dr. R. E. Wilson's paper (*A.J.*, **35**, 40, 1923). The stars are divided into two equal groups ranging from 60 to 420 and from 480 to 1520 parsecs. The result is

$$R = 3.01 \times 10^{11} \text{ a. u.}$$

Next, the formula is applied to 35 stars of the O-type, as observed by Professor J. S. Plaskett (*Publ. D.A.O.*, **2**, 328, 1924). These are divided into two groups, of 18 and of 17 stars, ranging from 310 to 890 and from 910 to 1440 parsecs. The result is

$$R = 3.25 \times 10^{11} \text{ a. u.}$$

The good agreement of these two values has seemed encouraging enough for a similar treatment of a much larger number of stars. Lastly, therefore, the formula is applied to all of the 1105 stars in the list of R. K. Young and W. E. Harper (*Publ. D.A.O.*, **3**, No. 1, 1924). whose distances do not fall below 50 parsecs and whose velocities v do not exceed 100 km/sec. The total material of 459 thus obtained is divided into two groups, of 229 and 230 stars, ranging from 50 to 100 and from 100 to 1000 parsecs. The resulting radius is

$$R = 4.03 \times 10^{11} \text{ a. u.}$$

which still agrees materially with the two preceding R-values. It has, in view of the numerosity of the group, by far the greater weight and can be accepted, say to two figures, as the actual value of the curvature radius.

This value is some 15 times smaller than that derived in 1924 from 18 clusters and the Magellanic Clouds with the aid of a statistical formula which had to be based on an arbitrary assumption about the unknown star-constants r_0, since the proper motions of these distant objects are not available. The present value, $R = 4 \times 10^{11}$, based on a much greater number of objects and derived by a method free from the last-named objection, can claim a much higher degree of reliability. Moreover, according to a private communication of Professor Shapley's, the distances of the clusters are now being thoroughly revised and the Greater Magellanic Cloud "will probably move in considerably."

It thus seems quite possible that after this revision of distances the globular clusters and the Clouds, too, will yield a radius of the order of 3 to 4×10^{11} a. u., which thus far stands best supported, viz. by $24 + 35 + 459$ stars.

ON THE INTERPRETATION OF THE AURORA SPECTRUM.

By V. M. Slipher and L. A. Sommer.

The spectrum of the auroral display of July 7, 1928, observed at the Lowell Observatory, contains besides usual auroral spectrum of negative nitrogen bands near λ 3914, λ 4278, λ 4708, the green aurora line λ 5577.350 and some other weaker ones, a very interesting line near 5206 A. We here attempt to interpret this line on the basis of the quantum theory.

J. J. Hopfield, K. T. Compton and J. C. Boyce analyzed among others, the metastable terms of the electronic configuration $2s^2 2p^3$ of the nitrogen atom. The term combinations give the following wave-lengths in air:

$$2p\ {}^4S_{3/2} - 2p\ {}^2D_{5/2,3/2} = \nu 19202 = \lambda 5206.3$$
$$2p\ {}^4S_{3/2} - 2p\ {}^2P_{3/2,1/2} = \nu 28808 = \lambda 3470.2$$
$$2p\ {}^2D_{5/2,3/2} - 2p\ {}^2P_{3/2,1/2} = \nu 9606 = \lambda 10407.3$$

Hence we interpret the observed line:

$$\lambda 5206 = 2p\ {}^4S_{3/2} - 2p\ {}^2D_{5/2,3/2}$$

as belonging to the spectrum of the neutral nitrogen atom. Reference to Kayser's Handbuch V, p. 57, suggests that this line may be often present in the aurora spectrum. Since $2p\ {}^4S_{3/2}$ is the normal state of the nitrogen atom the energy of excitation of the line is *2.37 volts.* It may be mentioned that the corresponding oxygen line ($2p\ {}^3P_2 - 2p\ {}^1D_2$) has not yet been observed.

The lines λ 3470.2 and λ 10407.3, which should be much less intense than the line λ 5206 and are unfavorably placed, have not yet been observed.

Thus the line λ 5206 by this interpretation indicates the presence of nitrogen atoms in the upper atmosphere during an auroral display.

LEGAL TIME IN CANADA.

By C. C. Smith.

Legal standard time in Canada is established by Acts of the different Provinces, defining time where that expression occurs in any law. Subsequently to the passing of the war measure in 1918 requiring the adoption of Daylight Saving for that year, the Provinces extended the scope of their laws to include similar Daylight Saving Acts covering whole provinces or separate municipalities. Ontario and Quebec have included as subject to provincial control the time tables of provincial railroads and other carriers.

This regulation of standard time is evidently very limited in its application. Consequently the boundaries of standard time zones in practice

differ in many places from the boundaries defined by provincial acts.

The legal boundaries of the standard time zones are: the west boundary of New Brunswick and thence north along the 68th meridian; the 90th meridian, thence along the eastern boundary of Manitoba to Hudson Bay, thence northerly and along the 85th meridian; the boundary between Manitoba and Saskatchewan and north along the 102nd meridian; the boundary between British Columbia and Alberta and thence north along the 120th meridian; and the east and south boundaries of the Yukon territory.

THE SOLAR ECLIPSE OF MAY 9, 1929, AS OBSERVED IN MALAYA.

By H. T. Stetson.

Following the policy of recent expeditions from the Harvard Astronomical Laboratory, the expedition to Malaya for this eclipse was devoted chiefly to photometric investigations of the corona.

The probable change in brightness of the corona with the changing sun-spot cycle makes it appear especially desirable to obtain data on as many different eclipses as possible, in order to ascertain just what effect varying solar activity has on the solar envelope.

Our outfit consisted of a Macbeth Illuminometer for measuring the total brightness of the sky and the corona during both the partial and total phases; a King Corona Photometer for registering photographically the brightness of the corona both in yellow and in ordinary light; and also a violet camera constructed at the Mt. Wilson Observatory for the work of Dr. Edison Pettit; a Multiple Coronagraph with lenses of various apertures and focal lengths for photographing the corona in light of different wave-lengths with appropriate filters; and an especially adapted cinemagraphic apparatus with automatic control for giving a complete record of the eclipse and sky.

Our expedition, consisting of Mr. and Mrs. Arnold, Mr. Josef Johnson, and H. T. Stetson, sailed from San Francisco on March 22 for Penang. We were joined en route by Mr. P. N. Gray of New York, who assisted in the photographic work. The site selected was at Alor Star, the capital of the Province of Kedah in the Malay Peninsula.

The morning of the eclipse gave fair promise for success, but increasing cloudiness at eclipse time interfered considerably with the photometric program although revealing a quite satisfactory view of the corona.

Photographs of the corona seen through the cirrus cloud were made on a panchromatic emulsion through Wratten F and Wratten K filters with varying exposures. The most satisfactory exposure was one of 30 seconds through the red "F" filter. The ultra-violet camera was exposed for the entire duration of totality and gave an appreciable image of the corona in ultra-violet light, in spite of the layer of cloud. The cinemagraphic record was very satisfactory and exhibits the "diamond ring" phenomena with great effectiveness.

The illuminometer readings indicated that the total illumination at

mid-totality was 0.15 of a foot candle, a value slightly in excess of the results obtained at Sumatra in 1926.

Further details of the photometric readings will be published elsewhere. A general account of the expedition appears in POPULAR ASTRONOMY, Vol. 37, No. 7.

ASTRONOMY AND THE CANADIAN GOVERNMENT.

BY R. MELDRUM STEWART.

A brief sketch was given of the circumstances leading up to the founding of the Dominion Observatory in 1905 as a logical outgrowth of government survey operations. The Geodetic Survey was originated and developed as a division of observatory work, and in 1917 was established as a separate institution. The need was early recognized of a larger equatorial telescope, and in 1918 this was provided through the establishment of the Dominion Astrophysical Observatory at Victoria. The two observatories constitute the Astronomical Branch of the Department of the Interior. The paper concluded with a short enumeration of the different activities, both astronomical and geophysical, in which the Dominion Observatory is engaged.

SIR ISAAC NEWTON'S LIBRARY.

BY JAMES STOKLEY.

In 1920 a lot of old books from a house at Thame Park, in Oxfordshire, were sold by Mr. Wykeham Musgrave of Barnsley Park at rubbish prices, even though a few were autographed "Js. Newton." Some of these books eventually found their way to a London dealer. Through this firm many reached American libraries.

A thorough search at Barnsley Park by Col. R. de Villamil has unearthed 858 volumes, all of which were established as coming from Newton's library. Previously, at Somerset House, Col. de Villamil had found the original inventory of Newton's effects at the time of his death, showing that the library then contained 1896 books, and was valued at £270. He found among the books a catalogue prepared about 1740 by Dr. James Musgrave.

Chief of the treasures in the library are copies of the first and second editions of the *Principia*, corrected and revised throughout by numerous notes in Newton's writing. These copies formed the basis of later editions, but all the corrections were not adopted. There is also a corrected copy of the first edition of his *Opticks*. The library is now on sale *en bloc*.

PRESSURE EFFECTS IN STELLAR SPECTRA.

BY OTTO STRUVE.

The broadening of many spectral lines in the laboratory is now known to be due chiefly to the Stark effect between neighboring atoms and charged electrons or ions. This type of broadening affects chiefly the members of the diffuse series. Other series are affected much less. Thus the "diffuse" helium lines have a tendency to be wide and hazy,

but they can be made quite sharp and narrow by reducing the pressure in the discharge tube.

It appears that the spectra of B-type stars clearly show the difference in the appearance of various helium series. The diffuse lines are always hazier than the members of the other series, and this applies to both triplet and singlet systems. The effect is well shown in the spectra of 88 γ Pegasi, 85 ι Herculis, and 17 ζ Cassiopeiae. In a few stars the difference in haziness is not so pronounced. For example the stars 67 Ophiuchi, 21 ϵ Canis Majoris, and 44 ζ Persei show the diffuse helium lines only very slightly hazier than the members of other series. These stars are all suspected to be very luminous. The first two are mentioned in the Henry Draper Catalogue as having narrow lines. All three seem to have narrow hydrogen lines, which are unusually free from wings, and in all three the forbidden helium line at 4470 is either very faint or completely missing. It is believed that we are dealing here with an effect of absolute magnitude; the luminous giants have comparatively rare atmospheres of low pressure, while in the dwarfs the atoms and electrons are packed much closer due to the greater surface gravity. Consequently the Stark effect, which is very sensitive to pressure, will be more pronounced in the dwarfs than in the giants.

This study applies only to stars in which the lines of ionized carbon (4267), of doubly ionized silicon (4552, 4567, and 4574), and of singly ionized magnesium (4481) are perfectly sharp. These lines are not very susceptible to Stark effect and their sharpness serves as a criterion for the elimination of stars in which all lines are widened by axial rotation.

The wave-length of the unknown stellar line at 4469.84 I.A. is found to agree very well with the wave-length for the forbidden helium line 4469.92 I.A. The difference is in the sense in which the line is displaced by the electric field, and suggests that the average electric field between neighboring particles is of the order of a little more than 10^3 volt/cm. This would correspond to pressures of the same order of magnitude as given by the theory of ionization.

The wave-lengths of several helium lines have been measured. They indicate that the lines are slightly shifted from their normal positions in the direction in which the Stark effect would broaden them in the laboratory. The amount of the shift agrees well with the average field intensity found above. For 67 Ophiuchi the shift seems to be less than for stars with strong Stark-effect. This also suggests that the pressure in the atmosphere of this star is lower than normal. A rough estimate leads to a pressure about 5 times smaller than the average pressure in 88 γ Pegasi, 85 ι Herculis, and 17 ζ Cassiopeiae.

THE STELLAR CALCIUM LINES IN SPECTRAL TYPES A AND B.

By Otto Struve and C. D. Higgs.

The contours of the calcium lines H and K were measured in four stars of type A on plates taken with a dispersion of 6.5 A/mm. The contour for α Lyrae agrees very well with the theoretical contour given

by Unsöld. For α Cygni the observed contour is wider in the middle and falls off more rapidly near the edges of the line. An approximate fit with Unsöld's curve gives for the total number of absorbing atoms:

α Lyrae: $N.D = 3.5 \times 10^{16}$
α Cygni: $N.D = 1.0 \times 10^{17}$

The Ca^+ lines of α Aquilae and of α Ophiuchi are shallow in the center and very wide, so that they cannot satisfactorily be represented by Unsöld's curve. These stars have apparently "dish-shaped" lines of the same type as the shallow He-lines observed by Elvey in many stars, and attributed by him to rapid axial rotation.

In order to obtain approximate values of N.D for earlier types, we have used estimates of the central intensity of the Ca^+ lines in a large number of stars. From these estimates we have computed the total absorbed energies and assumed that they are given by Unsöld's contour, corrected for the error in the center of the line. The values of N.D thus obtained are:

A2 : 4×10^{16}
A0 : 1×10^{16}
B9 : 7×10^{15}
B8 : 5×10^{15}
B5 : 3×10^{15}

By the same method we obtain for α Lyrae: $N.D = 2 \times 10^{16}$.

A NEW METHOD OF DRIVING A TRAVELING-WIRE MICROMETER.

By C. B. Watts.

One of the small transit instruments at the Naval Observatory has been provided with a new driving mechanism, consisting of a small synchronous motor mounted on the micrometer and geared directly to the screw without the interposition of a speed regulating device. Since the speed of the motor is dependent only on the frequency of the alternating current which drives it, the rate at which the wire moves can be adjusted to suit the declination of a star by altering the frequency.

Various ways of producing a current of suitable frequency are available. It is unnecessary to use a true alternating current, and it has been found convenient in practice to change a direct current, by means of a rapidly revolving commutator, into a rough approximation to a two-phase alternating current. The commutator is made to revolve at a speed corresponding to a particular declination by means of a friction driving mechanism. The observer causes the brushes to rotate in one direction or the other about the commutator and thus alters the frequency by such amounts as are necessary to keep the star bisected. This auxiliary apparatus is some distance from the instrument and is controlled by means of a push button in the observer's hand.

While the apparatus is still in an experimental state, time determinations have been made with it on 17 nights. The probable error of a single observation, including errors of star places, was found to be $0^s.012 \sec \delta$.

SOME MEASUREMENTS OF THE SOLAR ROTATION.

By C. R. Westland, J. L. O'Connor, and R. E. DeLury.

Recent measurements of spectroscopic observations at λ 5600 made in May and June, 1914, and 1916, yield 1.90 km/sec for the equatorial velocity of the solar rotation. The average for groups of observations in the years 1909-1917 is about 1.95. The 1914 and 1916 measures show a greater excess of the values for the strong lines over the weak lines on the plates yielding the lower values for the rate of rotation than on those giving the higher rates, in accord with previous measurements and in harmony with the supposition of varying amounts of blended spectrum.

THE CONSTRUCTION OF A 19-INCH REFLECTING TELESCOPE.

By R. K. Young.

A 19-inch reflecting telescope has been completed in the workshop of the astronomical department of the University of Toronto. The mirror is made of pyrex and is mounted in an open tube carried on a single-pier equatorial mounting. The focal length is 125 inches. The telescope is driven by an electric motor using the Gerrish electric control.

THE DETERIORATION OF SILVER MIRRORS WITH AGE.

By R. K. Young and Mrs. V. Krotkov.

A comparison with the reflecting power of freshly deposited silver on glass as given in the *International Critical Tables* and elsewhere suggests that when a silver coat looks perfect it may reflect several per cent different from another coat which looks equally good. The variation in published values is greater in the violet than in the red. In the yellow, orange, and red part of the spectrum the reflecting power is given as about 90 to 95 per cent and in the violet part, at λ 3500, as 60-68 per cent. Repeated trials failed to give any silver coats with a reflecting power as high as these in the violet, though the values in the red were closely approached. The conclusion drawn was that even when a silver film looks perfectly bright and clean it may reflect fully ten per cent less than the possible values.

Measures were also made of the deterioration of a silver mirror with age. Several trials showed that when any tinge of yellow could be detected with the eye, the mirror was not reflecting over 50 per cent at λ 4000. The deterioration was most marked in the violet.

Measures of polished chromium steel showed a reflecting power of about 70 per cent from λ 4000 to 7000. The deterioration in a year's time was negligible.

PLANET NOTES FOR MARCH

By CLIFFORD E. SMITH.

The *Sun* during this period will be moving in a northeasterly direction from the central part of Aquarius to the central part of Pisces. On March 21 it will pass through the Vernal Equinox, and the instant when the sun is at this point marks the beginning of spring. The position of the sun on March 1 and March 31 will be respectively: R.A. $22^h\ 45^m$, Decl. $-7°\ 57'$; and R.A. $0^h\ 35^m$, Decl. $+3°\ 47'$.

The phases of the *Moon* will occur as follows:

First Quarter	March	7 at	10 P.M.	C.S.T.
Full Moon		14 "	1 P.M.	"
Last Quarter		21 "	9 P.M.	"
New Moon		29 "	12 P.M.	"

The moon will be at perigee on March 12, and apogee on March 24.

Mercury will be in Capricornus early in the month and it will rise about an hour before the sun. On March 1 it will be in conjunction with Mars. At that time they will be separated by a distance about equal to the diameter of the moon. Late in the month the apparent position of Mercury will be near to that of the sun.

Venus will be near the sun in apparent position during the first part of this period. By the end of the month, however, it will set about an hour after the sun in western Pisces.

Mars will be in southern Aquarius, and during the latter part of the month it will rise about two hours before the sun. On March 1 it will be in conjunction with Mercury, and on March 27 it will be in conjunction with the moon.

Jupiter will be in Taurus about five degrees north of Aldebaran. During the middle of the month it will be on the meridian about 5:00 P.M. Standard Time. On March 7 it will be in conjunction with the moon. Its apparent motion during this period will be direct.

Saturn will be in central Sagittarius, and its apparent motion will be direct. During the middle of this period it will be on the meridian about 7:00 A.M. Standard Time. On March 22 it will be in conjunction with the moon. Its apparent motion will be direct.

Uranus will be in conjunction with the sun on April 1 and thus its apparent position during this period will be near that of the sun.

Neptune will be in Leo some few degrees in an easterly direction from Regulus, and its apparent motion will be retrograde. On March 13 it will be in conjunction with the moon. During the middle of the month it will be on the meridian about 11:00 P.M. Standard Time.

VARIABLE STARS

Monthly Report of the American Association of Variable Star Observers for December, 1929.

Again the Association is bereft of the services of its Treasurer, the late Michael J. Jordan of Boston, Massachusetts. Mr. Jordan had performed the arduous duties of his office with true devotion to our interests, and his sudden death, on December 22, will be mourned by all who had occasion to know him.

Variable Star Observations Received During December, 1929.

Oct. 0 = J.D. 2425885; Nov. 0 = J.D. 2425916; Dec. 0 = J.D. 2425946.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

V Scl
000330
886 11.3 Dr
889 11.0 Bl
904 11.9 Bl
913 12.8 Dr
916 12.8 Bl
923 13.2 Dr
936 13.7 Dr
950 14.4 Dw

S Scl
001032
886 7.3 Dr
889 7.5 Bl
890 7.5 Kd
891 7.5 Kd
892 7.5 Kd
899 6.9 Dr
904 6.4 Bl
908 7.1 Ht
913 6.8 Dr
914 7.3 Ht
916 7.3 Bl
916 7.4 Kd
918 7.4 Kd
920 7.4 Kd
920 7.1 Dr
936 7.5 Dr
938 7.7 Kd
941 7.7 Kd
942 7.9 Kd
943 8.0 Kd
943 7.6 Dw
946 8.1 Kd
946 8.2 Kd
949 7.7 Dw
951 8.2 Kd

X And
001046
939[13.0 Lj
945 13.7 Bw

T Cet
001620
889 6.5 Kd
891 6.5 Kd
916 6.7 Kd
918 6.7 Kd
920 6.7 Kd
922 6.6 Tf
930 6.0 Tf
934 6.5 Kd
938 6.5 Kd
938 5.8 Tf
941 5.9 Tf
941 5.9 L
941 6.5 Kd
944 6.5 Kd
945 5.8 Tf
946 6.6 Kd

T Cet
001620
950 6.5 Kd

T And
001726
936 13.5 Ch

T Cas
001755
920 7.5 Ch
925 7.6 B
931 7.4 Cr
931 7.5 Mb
934 7.6 Mb
935 7.2 Al
936 7.6 An
937 7.7 Cr
939 7.8 Pt
941 7.7 Jo
943 7.9 L
947 8.0 Jo
950 7.9 C
950 7.9 Ho
954 8.0 Mb
967 9.0 C
967 9.0 Ho

R And
001838
920 8.7 Ah
922 8.6 Ah
923 8.6 Ah
924 8.6 Ah
925 8.5 Ah
925 8.1 B
927 8.5 Ah
929 8.4 Ah
935 8.4 Ah
935 8.2 Ch
936 8.5 Ah
936 8.8 An
937 8.6 Ah
938 8.4 Ah
939 8.5 Ah
939 7.8 Pt
943 8.2 Kd
944 8.2 Kd
946 8.2 Kd
946 8.8 Fd
950 8.3 Kd
950 8.0 C
950 8.1 Ho
954 7.9 Ma
967 8.3 C
967 8.3 Ho

S Tuc
001862
887 14.6 Dr
887 14.3 Dw
890[14.0 Bl
908[13.2 Ht

S Tuc
001862
916[14.0 Bl
936[13.7 Dr
950 14.4 Dw

S Cet
001900
917 11.6 Ch
932 11.0 L
935 11.6 An
946 10.7 L
951 10.6 Sf

T Scl
002438a
886 12.5 Dr
913 13.1 Dr
920 13.0 Dr
936 12.3 Dr

RR Sct
002438b
886 13.0 Dr
913 12.9 Dr
923 13.0 Dr

T Phe
002546
886 10.3 Dr
889 10.6 Bl
899 11.1 Dr
904 11.6 Bl
908 12.2 Ht
913 12.0 Dr
916 12.1 Bl
920 12.2 Dr
936 12.8 Dr

W Scl
002833
890 13.1 Bl
913 13.1 Dr
916 13.0 Bl
923 13.0 Dr

U Cas
004047
936[13.3 Ch

RW And
004132
922 9.1 Tf
924 9.2 B
936 9.9 Ch
939 10.3 Pt
943 10.4 L

V And
004435
936 10.9 Ch

X Scl
004435
890 14.0 Bl
916 13.1 Bl

004533

RR And
011272
936[13.3 Ch

RV Cas
004746a
936[13.2 Ch

— Cas
004746b
939 10.7 Pt

W Cas
004958
920 9.7 Ch
924 9.6 BL
935 9.0 BL
939 8.7 Pt
941 8.7 Jo
942 8.8 BL
944 9.0 BL
946 8.8 BL
947 8.6 Jo
949 9.4 Bw
949 8.6 BL
950 8.5 BL
952 8.9 BL
955 8.8 BL
960 8.4 BL
961 8.5 BL

U Tuc
005475
886 9.2 Dr
889 9.0 Bl
899 8.6 Dr
904 8.6 Bl
908 8.7 Ht
913 8.5 Dr
914 8.8 Ht
916 8.5 Bl
920 8.6 Dr
936 9.3 Dr

Z Cet
010102
910 10.5 Ch
939 8.5 Pt

U Scl
010630
890[13.8 Bl
916[13.5 Bl
950 15.1 Dw

U And
010940
936 12.4 Ch

UZ And
011041
936 12.8 Ch
951 13.5 Bw

S Psc
011208
936[13.2 Br
943 14.5 L

S Cas
011272
938[13.5 Ch

U Psc
011712
936 12.0 Br
939 12.1 Pt
943 12.1 L
949 12.3 Al

R Scl
012233a
913 6.4 Dr
918 7.8 Kd
920 6.3 Dr
920 7.8 Kd
938 7.8 Kd
942 7.7 Kd
946 7.7 Kd
949 7.7 Kd

RS Scl
012233b
913[13.4 Dr
923[13.5 Dr

RZ Per
012350
938 10.4 Ch
945 10.0 L

R Psc
012502
920 9.5 Ah
922 9.3 Ah
923 9.7 Ah
924 9.6 Ah
925 9.4 Ah
927 9.4 Ah
936 9.3 Ah
936 8.8 Br
937 9.1 Ah
938 9.1 Ah
939 9.2 Ah
939 8.7 Pt

RU And
013238
936 10.7 An
938 10.5 Ch
939 11.1 Pt
946 11.2 L

Y And
013338
936 13.3 An
938 13.4 Ch
946 13.6 L

X Cas
014958
936 12.6 Pt
948 12.3 Bn

U Per
015254
920 8.4 Ah
922 8.0 Ah
924 8.4 Ah
929 8.4 Ch
936 8.2 Ah
937 8.1 Ah
939 8.2 Ah
939 8.3 Pt

XX Per
015654
924 8.0 Ch

S Ari
015912
943 13.4 L

R Ari
021024
923 11.5 Ch
936 10.8 Ah
937 10.6 Ah
938 10.5 Ah
939 10.5 Ah
939 10.5 Pt
943 10.3 L
944 10.4 Ae
951 9.7 Fd
954 9.2 Ma

W And
041143a
894 12.5 Bw
923 13.3 Ch

T Per
021258
924 8.8 Ah
935 9.0 BL
936 8.8 Ah
938 8.5 Pt
939 8.8 Ah
942 9.0 BL
946 8.8 BL
949 9.0 BL
950 8.9 BL
952 9.0 BL
955 8.9 BL
960 8.9 BL

Z Cep
021281
929 13.8 L
935 13.7 Br
943 13.3 L

o Cet
021403
890 8.7 Kd
891 6.7 Kd

Variable Star Observations Received During December, 1929.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
o Cet			R Cet			W Per			Y Per			T Cam			R Pic		
021403			*022000*			024356			032043			043065			*044349*		
892	6.9	Kd	943	13.0	L	929	9.8	Ch	954	9.1	Mb	949	10.6	BL	906	8.6	Ht
916	6.8	Kd	RR Per			931	9.1	Cr	955	9.3	BL	950	10.8	BL	914	8.6	Ht
918	7.4	Kd	022150			931	9.0	Mb	960	9.3	BL	952	10.8	BL	916	8.0	Bl
920	7.4	Kd	929	11.3	Ch	938	9.7	Pt	R Per			955	10.9	BL	916	8.0	Dr
920	7.7	Ah	929	11.8	L	941	9.0	Jo	032335			RX Tau			920	7.9	Dr
922	8.3	Tf	938	11.7	Pt	947	9.2	Jo	936	13.3	Br	043208			936	7.3	Dr
922	7.9	Ah	945	12.2	L	951	9.8	B	944	12.8	Al	920	10.5	Ch	V Tau		
923	7.9	Ah	952	12.4	B	954	9.3	Mb	945	13.1	L	927	11.1	L	044617		
924	7.9	Ah	R For			R Hor			T For			938	12.0	Pt	920	9.1	Ch
925	7.9	Ah	*022426*			*025050*			*032528*			941	11.5	B	941	9.0	B
927	7.9	Ah	889	10.3	Bl	886	12.7	Dr	941	9.1	L	946	11.9	L	R Ori		
935	8.3	Ah	904	10.1	Bl	889	12.6	Bl	U Eri			R Ret			045307		
936	8.3	Ah	916	10.3	Bl	904	12.6	Bl	*034625*			*043263*			926	9.4	L
937	8.3	Ah	U Cet			906	12.8	Ht	886	11.7	Dr	889	10.5	Bl	928	9.0	Ch
937	8.4	Tf	*022813*			913	12.3	Dr	913	12.7	Dr	899	11.0	Dr	946	9.5	L
938	8.5	Ah	920	9.8	Ch	914	12.8	Ht	923	13.6	Dr	904	11.3	Bl	R Lep		
938	8.3	Pt	938	8.2	Pt	916	12.4	Bl	941	13.9	L	906	11.8	Ht	*045514*		
938	8.5	Ch	950	7.8	Kd	920	12.3	Dr	T Eri			913	11.9	Dr	916	6.0	Ch
938	7.7	Kd	RR Cep			947	11.7	Dw	*035124*			914	11.8	Ht	927	6.4	L
938	8.7	Tf	022980			949	11.4	Dw	886	10.0	Dr	916	11.7	Bl	927	5.7	Tf
939	8.5	Ah	929	13.9	L	T Hor			899	9.4	Dr	923	12.1	Dr	930	5.7	Tf
941	8.0	Jo	936	13.1	Br	*025751*			913	8.3	Dr	950	13.3	Dw	930	6.3	Ch
941	8.6	Tf	943	12.5	L	886	7.6	Dr	920	7.7	Dr	X Cam			933	5.8	Tf
941	8.3	Kd	R Tri			889	8.1	Bl	936	7.8	Dr	043274			937	6.0	Tf
942	8.2	Kd	023133			899	7.8	Dr	W Eri			929	11.4	L	938	6.5	Pt
942	8.4	BL	918	9.7	Ch	904	8.2	Bl	*040725*			938	10.6	Pt	941	5.8	Tf
943	8.4	Kd	920	9.3	Ah	906	8.3	Ht	886	12.8	Dr	939	10.4	Br	941	6.6	Jo
943	8.4	L	922	9.3	Ah	913	8.7	Dr	913	12.6	Dr	941	10.3	Ch	943	5.8	Tf
944	8.0	Al	922	9.6	Tf	914	9.1	Ht	923	12.0	Dr	946	9.4	L	945	6.8	Ma
946	8.3	Kd	923	9.2	Ah	916	8.9	Bl	936	11.8	Dr	951	8.1	B	946	6.7	L
946	8.6	BL	924	9.2	Ah	936	10.3	Dr	R Tau			R Dor			947	6.5	Jo
947	8.5	Jo	925	9.1	Ah	U Ari			042209			*043562*			V Ori		
949	8.4	Kd	927	9.1	Ah	030514			920	10.5	Ch	886	5.0	Dr	050003		
950	8.4	Kd	928	9.4	Tf	939	13.6	Br	922	8.9	Tf	889	5.3	Bl	928	13.6	L
950	8.8	Gb	935	9.0	Ah	X Cet			938	9.2	Tf	904	5.3	Bl	938	12.7	Pt
952	8.6	BL	935	8.9	Sf	*031401*			938	10.8	Pt	906	5.2	Ht	946	12.8	L
954	8.7	Ma	936	9.0	Ah	894	10.4	Bw	941	10.5	B	913	4.8	Dr	T Lep		
955	8.8	BL	937	8.9	Ah	914	8.9	Bw	954	10.4	Ma	914	5.3	Ht	*050022*		
960	8.7	BL	938	8.9	Ah	935	8.7	An	W Tau			916	5.2	Bl	889	11.5	Bl
S Per			938	8.8	Pt	938	8.8	Pt	042215			923	4.9	Dr	904	10.6	Bl
021558			938	8.5	Tf	941	8.7	Jo	920	9.0	Ch	R Cae			916	10.5	Bl
924	9.5	Ah	939	8.9	Ah	942	8.5	Bw	938	9.5	Pt	*043738*			938	10.0	Pt
935	9.4	BL	941	8.0	Jo	942	8.8	Ch	940	9.5	L	886	9.0	Dr	S Pic		
936	9.6	Ah	941	8.4	Ch	943	8.5	L	941	9.5	B	889	9.0	Bl	*050848*		
938	9.5	Pt	941	8.5	Tf	947	9.3	Jo	941	9.4	Jo	899	9.4	Dr	886	9.1	Dr
939	9.5	Ah	942	8.8	Kd	949	8.9	Sf	947	9.7	Jo	904	9.5	Bl	889	9.6	Bl
942	9.3	BL	943	8.8	Kd	951	8.9	Bw	949	9.5	Al	906	9.8	Ht	899	8.7	Dr
944	10.2	Al	946	8.9	Kd	952	8.8	B	T Cam			914	10.0	Ht	904	7.7	Bl
946	9.5	BL	947	8.5	Sf	954	8.9	Sf	043065			916	9.8	Bl	906	8.7	Ht
949	9.4	BL	947	7.9	Jo	Y Per			929	9.4	L	916	10.0	Dr	914	8.5	Ht
950	9.4	BL	950	8.5	Kd	032043			935	10.3	An	923	10.2	Dr	916	7.9	Dr
952	9.3	BL	954	8.0	Sf	929	9.9	Ch	938	10.5	Pt	943	11.2	Dw	916	8.3	Bl
952	9.4	B	954	7.5	Ma	935	9.5	BL	939	10.6	Br	R Pic			920	7.7	Dr
955	9.5	BL	954	7.9	Mb	938	9.9	Pt	941	10.8	Ch	*044349*			936	8.1	Dr
960	9.5	BL	967	7.5	Ho	942	9.4	BL	942	10.2	BL	886	9.0	Dr	R Aur		
R Cet			967	7.4	C	946	9.6	BL	944	10.4	BL	889	8.8	Bl	050953		
022000						949	9.4	BL	946	10.4	BL	899	8.5	Dr	922	13.0	Ch
938	12.5	Ch				950	9.4	BL	946	10.5	L	904	8.0	Bl	938	13.5	Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T PIC	T ORI	U AUR	α ORI	X AUR	R LYN
051247	*053005a*	053531	054907	060450	065355
886 10.5 Dr	931 10.0 L	928 13.5 L	928 0.6 L	933 9.8 Lj	920 9.3 Ah
889 11.0 Bl	932 10.0 L	946 13.4 L	940 0.6 L	935 9.9 Lj	922 9.5 Ah
908 13.1 Ht	935 9.8 An	SU TAU	U ORI	938 10.3 Ch	924 9.6 Ah
914 13.1 Ht	937 10.1 L	054319	054920a	939 10.3 Lj	925 9.6 Ah
916 13.6 Dr	937 10.3 Lg	916 9.8 Ch	920 6.9 Ah	942 10.4 Lj	927 9.5 Ah
Nov TAU	938 11.0 Pt	927 9.5 L	920 7.4 Kd	946 11.3 L	928 9.6 L
051316	940 10.1 L	929 9.4 L	922 6.6 Ch	950 11.1 Pt	936 9.9 Ah
928 14.0 L	941 10.1 L	929 9 7 Ch	922 6 9 Ah	V AUR	946 9.7 L
T COL	942 10.0 L	931 9.6 L	924 6.9 Ah	061647	V CMI
051533	943 9.7 L	932 9.4 L	925 6.9 Ah	932 12.0 Lg	070109
886 7.7 Dr	944 10.0 L	933 9.5 L	927 6.9 Ah	941 11.8 L	928 9.8 Ch
889 8.0 Bl	945 9.8 L	937 9.5 L	935 6.9 Ah	V MON	929 9.4 L
899 7.5 Dr	945 10.0 Ma	937 9.6 Pt	937 7.2 Ah	*061702*	946 11.3 L
904 7.7 Bl	946 10.3 Pt	938 9.6 Pt	938 7.1 Ah	928 7.0 Ch	R GEM
908 7.5 Ht	946 10.0 L	940 9.6 L	938 7.2 Fd	950 8.7 Pt	070122a
914 7.0 Ht	949 10.5 Pt	941 9.5 L	939 7.1 Ah	AG AUR	920 7.0 Ah
916 7.5 Bl	950 10.4 Pt	941 9.9 An	941 7.0 Jo	062047	922 6.8 Ah
916 7.1 Dr	952 10.5 Pt	942 9.5 L	943 7.4 Kd	926 9.7 L	924 6.7 Ah
920 7.3 Dr	AN ORI	943 9.5 L	946 7.0 Fd	932 9.6 L	925 6.7 Ah
936 7.7 Dr	*053005f*	944 9.5 L	947 7.5 Kd	941 9.5 L	927 6.4 Ah
950 8.5 Dw	927 11.6 L	945 9.6 L	947 7.2 Jo	R MON	928 6.0 Ch
S AUR	929 11.6 L	945 9.6 L	950 6.5 Pt	063308	935 6.4 Ah
052034	937 11.6 L	946 9.5 L	950 7.5 Kd	939 10.5 Ch	937 6.5 Ah
922 8.4 Ch	940 11.6 L	946 9.6 Pt	951 7 6 Fd	950 11.5 Pt	938 6.6 Ah
927 8.2 L	941 11.6 L	949 9.9 Pt	Z AUR	Nov PIC	939 6.5 Ah
935 9.0 An	942 11.6 L	950 9.7 Pt	055353	*063462*	941 6.5 Jo
937 7.8 Lg	943 11.6 L	950 9.5 B	935 10.0 Pt	908 8.1 Ht	947 6.7 Jo
938 8.3 Pt	944 11 6 L	952 9.6 Pt	937 10.0 Pt	914 8.1 Ht	950 6.4 Pt
942 8.4 BL	946 11.6 L	S COL	937 11.0 Lg	S LYN	Z GEM
944 8 4 BL	S CAM	*054331*	938 10.0 Pt	063558	070122b
946 8.6 BL	053068	886 9.2 Dr	940 10.1 Pt	914 12.7 Bw	950 12.4 Pt
946 8.6 L	938 8.4 Pt	889 9.6 Bl	941 10.0 Pt	928 11.4 L	TW GEM
949 9.0 BL	952 9.1 BL	899 9.4 Dr	942 10.1 Pt	939 9.9 Ch	070122c
950 8.8 BL	955 8.9 BL	904 9.6 Bl	944 10.1 Pt	945 10.2 Bw	950 8.2 Pt
952 8.5 BL	961 8 5 BL	908 10.2 Ht	945 10.2 Pt	946 9.8 L	R CMI
955 8.9 BL	RR TAU	914 10.4 Ht	946 10.2 Pt	950 9.5 Pt	070310
961 8.6 BL	*053326*	916 9.7 Bl	949 10.6 Pt	957 9.8 Bw	928 9.0 Ch
W AUR	917 11.7 L	916 9.4 Dr	950 10.6 Pt	X GEM	929 8.8 L
052036	917 11.6 L	920 9.5 Dr	951 10.6 Pt	064030	946 9.1 L
922 10.0 Ch	927 11.4 L	Z TAU	952 10.9 Pt	894 11.3 Bw	R VOL
926 9.8 L	928 11.3 L	054615a	952 10.6 B	913 12.6 Bw	*070772*
935 10.6 An	929 11.1 L	929 13 4 L	R OCT	942 13.9 Bw	886 10 2 Dr
937 10.5 Sf	931 11.6 L	RU TAU	*055686*	947 13.7 Bn	899 9.7 Dr
937 9.4 Lg	932 11.7 L	054615c	886 11.3 Dr	Y MON	908 10.9 Ht
938 10.0 Pt	933 11.9 L	929 12.6 L	889 11.1 Bl	065111	913 9.8 Dr
946 10.7 L	937 12.3 L	R COL	889 11.4 Ht	929 10.8 L	914 10.6 Ht
950 10.8 B	940 11.0 L	*054629*	908 12.0 Ht	939 11.6 Ch	920 9.7 Dr
S ORI	941 10.5 L	886 12.2 Dr	913 11.7 Dr	950 11.9 Pt	L_2 PUP
052304	942 10.5 L	889 12.2 Bl	914 12.0 Ht	X MON	*071044*
922 11.7 Ch	943 10.4 L	904 10.6 Bl	916 11.7 Bl	*065208*	886 4.9 Dr
932 11.8 Lg	944 10.4 L	908 10.3 Ht	923 11.7 Dr	928 7.2 Tf	899 5.0 Dr
938 12.6 Pt	945 10.8 L	914 10.2 Ht	X AUR	928 7.4 L	913 4.5 Dr
T ORI	945 10.7 L	916 9.8 Bl	060450	930 7.3 Tf	920 4.4 Dr
053005a	946 11.0 L	916 9.6 Dr	920 9.4 Lj	933 7.3 Tf	923 4.2 Dr
922 10.5 Ch	RU AUR	920 9.4 Dr	922 8.8 Ch	941 7.4 Tf	936 3.9 Dr
927 10.0 L	053337	943 9.5 Dw	927 9.6 Lj	943 7.2 Tf	RR MON
928 10.1 L	922[12.8 Ch		928 9.1 L	946 7.1 L	071201
929 10.1 L	954[12.1 Mb		931 9.8 Lj		928[13.2 Ch

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1929.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
V GEM			R CNC			R CAR			S CAR			S LEO			T UMA		
071713			081112			*092062*			*100661*			110506			123160		
913	9.5	Bw	927	11.4	Ch	899	7.8	Dr	916	6.3	Bl	949	11.5	Pt	926	9.7	Ch
928	9.7	Ch	950	11.8	Pt	908	8.4	Ht	920	6.1	Dr	RY CAR			927	9.5	Ah
929	9.6	L	V CNC			913	7.7	Dr	923	6.1	Dr	*111561*			936	10.0	Ah
945	11.4	Bw	081617			916	8.0	Bl	943	5.8	Dw	888[	13.1	Bl	937	10.2	Ah
950	11.2	Pt	927	12.6	Ch	920	7.2	Dr	947	6.0	Dw	RS CEN			938	10.2	Ah
S CMI			932	12.7	L	923	7.2	Dr	950	5.8	Dw	*111661*			938	10.5	Fd
072708			950	13.1	Pt	943	5.8	Dw	U UMA			886	9.4	Dr	939	10.2	Ah
928	7.5	Tf	RT HYA			947	5.5	Dw	100860			888	9.2	Bl	946	10.7	Fd
928	7.4	Ch	*082405*			949	5.4	Dw	926	6.4	Ch	899	10.2	Dr	949	10.2	Pt
932	7.6	Tf	950	7.8	Pt	X HYA			Z CAR			903	11.3	Bl	R VIR		
938	8.2	Fd	R CHA			*093014*			*101058a*			920	12.1	Dr	123307		
941	7.7	Jo	*082476*			927[	11.1	Ch	908[	12.3	Ht	923	12.4	Dr	949	8.1	Pt
943	8.0	Tf	890	12.3	Bl	Y DRA			950	10.6	Dw	X CEN			RS UMA		
946	7.8	Fd	908	11.8	Ht	093178			AF CAR			*114441*			123459		
950	8.3	Pt	914	11.7	Ht	927	9.6	Ch	*101058b*			920	8.7	Dr	929[	10.9	Ch
T CMI			916	11.3	Bl	932	9.3	L	950	10.8	Dw	W CEN			S UMA		
072811			U CNC			R LMI			W VEL			*115058*			123961		
928	10.5	Ch	083019			093934			*101153*			882	8.5	Dr	920	9.8	Ah
929	10.4	L	927	13.9	Ch	926	11.8	Ch	886	13.2	Dr	888	9.3	Bl	922	9.9	Ah
946	10.8	L	S HYA			938	7.8	Fd	908[	12.0	Ht	899	9.5	Dr	922	10.2	Lj
950	10.7	Pt	084803			946	8.8	Fd	923	13.6	Dr	903	10.1	Bl	924	10.0	Ah
S VOL			927	11.3	Ch	950	12.0	Pt	U HYA			920	10.9	Dr	925	10.2	Ah
073173			950	9.6	Pt	RR HYA			*103212*			R COM			926	9.7	Ch
886	13.6	Dr	T HYA			*094023*			928	5.3	L	115919			927	10.4	Ah
890	13.6	Bl	*085008*			886	13.1	Dr	939	5.0	L	927[	12.5	Ch	934	10.4	Lj
908[	13.2	Ht	927	11.9	Ch	920	13.8	Dr	942	6.0	Kd	SU VIR			936	10.6	Ah
916[	13.2	Bl	940	12.4	L	R LEO			RZ CAR			120012			937	10.6	Ah
923	13.8	Dr	T CNC			094211			*103270*			927[	12.5	Ch	938	10.5	Ah
U CMI			085120			926	8.2	Ch	920	10.9	Dr	R CRV			938	11.0	Fd
073508			927	9.5	Ch	928	8.5	Tf	923	10.7	Dr	*121418*			939	10.6	Ah
928	8.4	Ch	950	8.0	Pt	932	7.8	Tf	R UMA			928	8.0	L	940	10.8	Lj
929	8.4	L	V UMA			939	8.4	Ah	103769			941	7.2	L	941	11.4	Jo
946	8.5	L	090151			949	8.5	Pt	920	10.5	Ah	949	6.7	Pt	946	11.0	Fd
950	8.6	Pt	932	10.3	L	Y HYA			922	10.8	Ah	SS VIR			949	10.4	Pt
S GEM			940	10.3	L	*094622*			926	10.1	Ch	*122001*			RU VIR		
073723			W CNC			949	6.6	Pt	927	10.3	Ah	928	7.3	L	124204		
914[	13.6	Bw	090425			Z VEL			935	9.3	Ah	940	7.4	L	929	9.5	L
927	13.9	Ch	927	13.0	Ch	*094953*			936	8.9	Ah	T CVN			949	9.3	Pt
950	13.5	Pt	940	13.4	L	886	8.8	Dr	937	8.8	Ah	122532			U VIR		
957	12.8	Bw	RX UMA			899	9.1	Dr	938	8.6	Ah	929	9.8	Ch	124606		
W PUP			090567			908	9.8	Ht	939	8.6	Ah	949	9.4	Pt	928	8.1	L
074241			940	11.5	L	920	9.8	Dr	941	8.4	Jo	Y VIR			940	8.1	L
886	10.9	Dr	RW CAR			950	10.9	Dw	947	8.2	Jo	*122803*			949	8.1	Pt
899	9.9	Dr	*091868*			V LEO			949	7.7	Pt	928	9.4	L	RV VIR		
908	9.7	Ht	886	10.3	Dr	095421			V HYA			940	9.5	L	*130212*		
913	9.1	Dr	889	10.6	Bl	926[	11.9	Ch	*104620*			U CEN			944	11.3	L
916	9.1	Bl	908	11.8	Ht	927	13.5	Ch	926	8.2	Ch	*122854*			U OCT		
920	8.4	Dr	916	12.0	Bl	RV CAR			**929**	**6.7**	L	882	8.5	Dr	*131283*		
923	8.2	Dr	920	12.1	Dr	*095563*			945	7.1	L	888	8.8	Bl	882	9.0	Dr
T GEM			949	13.2	Dw	889[	13.1	Bl	949	6.5	Pt	899	9.2	Dr	888	9.4	Bl
074323			Y VEL			S CAR			W LEO			903	9.5	Bl	889	9.6	Ht
914	13.1	Bw	*092551*			*100661*			104814			920	10.7	Dr	903	10.4	Bl
927	11.7	Ch	886[	13.0	Dr	882	7.9	Dr	927	12.5	Ch	T UMA			906	10.3	Ht
950	10.7	Pt	908[	12.4	Ht	886	7.9	Dr	939	12.8	L	123160			913	10.9	Bl
U PUP			R CAR			889	7.8	Bl	S LEO			920	9.2	Ah	914	11.2	Ht
075612			*092062*			899	7.1	Dr	110506			922	9.3	Ah	916	11.1	Dr
928	13.3	Ch	886	8.5	Dr	908	6.7	Ht	927	11.8	Ch	924	9.5	Ah			
941	13.5	L	889	8.4	Bl	913	6.2	Dr	928	12.0	L	925	9.5	Ah			

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R HYA	R CEN	RS LIB	R CRB	X SCO	R DRA
132422	*140959*	*151822*	154428	*160221a*	163266
928 5.4 L	889 5.7 Ht	888 10.5 Bl	833 6.2 Km	889 11.2 Bl	922 11.3 Ch
941 4.8 L	903 5.7 Bl	889 11.2 Ht	851 5.7 Km	SX HER	927 11.7 Lj
942 5.0 Kd	906 5.7 Ht	R NOR	857 5 8 Km	160325	935 11.9 Lj
949 5.4 Pt	913 5.8 Dr	*152849*	869 5.9 Km	927 8.2 L	938 12.0 Pt
S VIR	913 5.9 Bl	887 6.9 Dr	877 6.0 Km	938 8.4 Pt	939 12.0 Lj
132706	923 6.0 Dr	888 6.5 Bl	879 5.7 Km	940 8 4 Pt	940 12.1 Lj
949 12.4 Pt	U UMI	889 7.2 Ht	890 6.2 Kd	941 8.5 Pt	S HER
RV CEN	141567	903 6.8 Bl	898 6.1 Kd	942 8.7 Pt	164715
133155	922 10.9 Lj	906 7.5 Ht	905 6.0 Kd	943 8.8 L	922 9.4 Ch
888 7.5 Bl	927 10 9 Lj	913 7.0 Bl	918 6.1 Ch	946 8.6 Pt	927 9.8 Ah
903 7.5 Bl	933 10.9 Lj	X LIB	922 5.9 Tf	949 8.3 Pt	929 9.9 Ah
913 7.7 Bl	935 10.9 Lj	*153020*	922 6.1 Lj	950 8.2 Pt	937 10.4 Ah
T CEN	939 11.0 Lj	889[12.8 Bl	924 6.0 Ah	W SCO	938 9.8 Pt
133633	939 11.2 Ah	W LIB	927 6.0 Ah	*160519*	RS SCO
882 6.4 Dr	949 11.7 Pt	*153215*	927 6.2 Lj	889 11.6 Bl	*164844*
889 7.3 Bl	S BOO	889[12.5 Bl	927 6.1 L	RU HER	888 8.0 Bl
RT CEN	141954	S UMI	929 6 0 Ah	160625a	889 8.0 Ht
134236	941 10.2 L	153378	931 6.2 Lj	917 11.1 Ch	903 9.0 Bl
882 12.4 Dr	949 9.9 Pt	920 8.6 Ah	933 6.2 Li	927 10.2 L	906 9.4 Ht
889 11 8 Bl	RS VIR	920 8.7 Lj	935 6.2 Lj	943 9.6 L	913 9.4 Pl
R CVN	142205	922 8.8 Lj	936 5.9 Ah	949 9.2 Pt	914 10.1 Ht
134440	941 8.2 L	922 8.6 Ah	937 6.0 Ah	R SCO	916 9.4 Dr
949 12.0 Pt	V BOO	924 8.5 Ah	938 6.1 Pt	*161122a*	928 10.7 Dr
RX CEN	142539a	925 8.6 Ah	939 6.2 Lj	888 10.9 Bl	RR SCO
134536	949 8.5 Pt	927 8.6 Ah	940 6.2 Lj	889 10.9 Ht	*165030a*
889[12.1 Bl	R CAM	927 8.8 Lj	940 6.1 Pt	913 10.8 Bl	888 5.9 Pl
T APS	142584	929 8.6 Ah	941 6.1 Pt	S SCO	889 5.9 Ht
134677	916 9.0 Ch	933 9.2 Lj	942 6.1 Pt	*161122b*	904 6.2 Bl
887 12.9 Dr	R BOO	933 8.8 Lj	942 6.0 L	889[12.6 Ht	906 6.1 Ht
887 12.4 Dw	143227	935 9.0 Lj	942 6.2 Lj	913[11 9 Bl	913 7.0 Pl
889 12.9 Ht	922 9.5 Lj	935 8.8 Sf	942 6.2 Kd	U HER	914 6.9 Ht
889 12.5 Bl	934 8.7 Lj	936 8.8 Ah	944 6.2 Lj	162119	916 6.8 Dr
903 11.7 Bl	940 8.6 Lj	937 8.7 Ah	945 6 1 Pt	919 7.2 Ah	928 7.3 Dr
906 12.0 Ht	942 8.6 Lj	938 8.9 Ah	946 6.1 Pt	923 7.2 Ah	RV HER
913 11.1 Bl	949 7 6 Pt	939 8.8 Ah	949 6.2 Pt	924 7.2 Ah	165631
914 11.3 Ht	Y LUP	939 9.1 Lj	X CRB	927 6.9 Ah	894 12.1 Bw
916 10.7 Dr	*145254*	941 9 3 Jo	154536	929 6.9 Ah	919[13.3 Ch
923 10.0 Dr	882 9.5 Dr	941 9.4 Lj	916[10.9 Ch	935 7.3 Sf	936[12.7 An
936 9.3 Dr	887 9.6 Dr	942 9.3 Lj	R SER	936 7.3 Ah	944[14.0 L
RR VIR	888 9.6 Bl	947 9.2 Jo	154615	937 7.4 Ah	RT SCO
135008	903 9.6 Bl	947 8.8 Sf	949 6.3 Pt	938 7.2 Pt	*165636*
949 12.5 Pt	913 10.0 Bl	949 9.0 Pt	V CRB	T OPH	888 10 9 Pl
Z BOO	S APS	954 9.3 Sf	154639	*162815*	904 11.5 Pl
140113	*145971*	U LIB	935 8.0 BL	889[12.8 Bl	913 11.8 Bl
941 11 3 L	886 11.1 Dr	*153620a*	949 7.6 Pt	S OPH	916 12.6 Dr
Z VIR	888 10.7 Bl	889[12.9 Bl	RZ SCO	*162816*	— DRA
140512	889 11.2 Ht	T NOR	*155823*	888 9.5 Bl	165752
942 11.0 L	903 10.9 Bl	*153651*	889 11.6 Ht	903 9.2 Bl	927 10.5 L
RU HYA	906 11.2 Ht	886 7.6 Dr	Z SCO	913 9.3 Bl	943 11.2 L
140528	910 11.3 Dr	889 7.7 Ht	*160021*	W HER	R OPH
882 8.3 Dr	913 10.8 Bl	906 7.5 Ht	888 9.7 Bl	163137	*170215*
887 8.2 Dr	914 10.9 Ht	914 7.5 Ht	889 9.9 Ht	919 13.0 Ch	916[11.3 Ch
889 8.0 Bl	916 11.0 Dr	Z LIB	903 9.3 Bl	938 13.2 Pt	RT HER
R CEN	923 11.1 Dr	*154020*	913 9.4 Bl	R UMI	170627
140950	936 11.3 Dr	889 12.4 Bl	U SER	*163172*	919[13.4 Ch
882 5.6 Dr	S CRB	R CRB	160210	941 9 3 Jo	RW SCO
886 5.3 Dr	151731	154428	936 9.1 An		*170833*
888 5.8 Bl	949 8.1 Pt	829 6.0 Km			888 10.5 Bl

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1929.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

RW Sco
170833
904 11.0 Bl
913 11.1 Bl
916 11.0 Dr
Z Oph
171401
929 8.9 Ah
938 8.7 Pt
S Oct
172486
882 14.0 Dr
882 13.8 Dw
889 13 4 Bl
908 13.0 Ht
914 12.5 Ht
914 12.5 Bl
923 12.0 Dr
RU Oph
172809
916 10.9 Ch
938 11.4 Pt
943 12.1 L
RU Sco
173543
886 8.6 Dr
889 8.6 Bl
904 9.0 Bl
914 9.1 Bl
916 9.1 Dr
928 9.5 Dr
936 9.6 Dr
SV Sco
174135
882 14.6 Dw
914 13 2 Bl
916 12.5 Dr
W Pav
174162
857 13.9 Dw
882 13.0 Dw
882 13.2 Dr
889 12.5 Bl
904 11.2 Bl
906 10.7 Ht
914 9.4 Ht
914 9.8 Bl
916 9.4 Dr
923 9.1 Dr
936 8.5 Dr
U Ara
174551
886 8.4 Dr
889 8.7 Ht
906 8.9 Ht
914 9 5 Ht
916 9.2 Dr
RT Oph
175111
919[12.8 Ch

T Dra
175458a
919 12.2 Ch
UY Dra
175458b
919 11.0 Ch
RY Her
175519
893 12.1 Bw
916 11.0 Ch
927 9.3 L
938 9.2 Pt
943 9.0 L
V Dra
175654
919[13.1 Ch
R Pav
180363
886 9.6 Dr
889 9.8 Ht
899 8.6 Dr
906 8.7 Ht
910 8.6 Dr
914 8 9 Ht
923 9.0 Dr
936 9.4 Dr
T Her
180531
919 12.5 Ch
927 13.0 L
936 12.6 An
938 12.4 Pt
943 12.9 L
W Dra
180865
919 12.8 Ch
927 12.9 L
935 13.4 Lg
938 14.0 Pt
943 12.9 L
X Dra
180666
927 12.0 L
943 12.0 L
RY Oph
181103
938 8.6 Pt
W Lyr
181136
927 9.1 L
931 8.6 Al
935 8.8 Sf
935 8.7 B
938 8.5 Pt
943 8.1 L
947 8.3 Sf
947 8.0 Md
950 8.3 Gb
954 8.1 Sf

RV Sgr
182133
889 11.6 Bl
904 12.3 Bl
914 12.9 Bl
916 12.4 Dr
SV Her
182224
893 13.3 Bw
919[13.0 Ch
944 14 2 L
T Ser
182306
893 11.6 Bw
938 11.7 Pt
SV Dra
183149
944 13.9 L
RZ Her
183225
919[13.0 Ch
X Oph
183308
928 8.3 L
931 8.0 Al
938 8.1 Pt
941 8.5 Jo
944 8.4 L
947 8.7 Jo
RY Lyr
184134
919[12.8 Ch
R Sct
184205
889 5.4 Kd
890 5.5 Kd
898 5.2 Kd
905 5.5 Kd
918 5 8 Kd
919 5.7 Ch
920 6.0 Kd
920 5.6 Bc
921 5.5 Bc
922 5.6 Lj
922 5.9 Tf
923 5.8 Bc
927 5.9 L
927 5.6 Lj
930 5.9 Bc
931 5.9 Bc
931 5.6 Lj
932 5.4 Tf
933 5.4 Lj
934 5.8 Kd
935 5 4 Lj
935 5.6 Pt
937 5.5 Pt
938 5.4 Pt
938 5.7 Kd
939 5.5 Pt

R Sct
184205
939 5.3 Lj
940 5.5 Pt
940 5.0 Lj
941 5.7 Jo
941 5.2 Tf
941 5.8 Kd
941 5.6 Pt
941 5.1 L
942 5.8 Kd
942 5.0 Lj
942 5.5 Pt
943 5.1 Tf
944 5.6 Pt
944 5.0 L
945 5.5 Pt
945 5.1 Tf
946 5.7 Kd
946 5.4 Pt
947 5.6 Jo
949 5.7 Kd
950 5.7 Kd
950 5.4 Gb
950 5.4 Pt
951 5.4 Pt
952 5.4 Pt
Nov Aql
184300
918 10.7 Ch
935 11 7 Pt
939 11.7 Pt
951 11.7 Pt
RX Lyr
185032
942 12.3 Mb
943 13.2 L
S CrA
185137a
889 11.8 Bl
914 11.8 Bl
R CrA
185537a
889 13.0 Bl
914 13.0 Bl
T CrA
185537b
889 13.5 Bl
914 13.5 Bl
Z Lyr
185634
919 10.5 Ch
928 10.4 L
935 10.4 B
937 10.6 Pt
944 10.6 L
SU Sgr
185722
889 8 2 Ht
906 8.2 Ht

SU Sgr
185722
914 8.4 Ht
RT Lyr
185737
919[13.0 Ch
944 13.0 L
R Aql
190108
936 11.2 Ah
937 11.2 Ah
937 10.9 Pt
939 10.9 Ch
939 11.1 Ah
V Lyr
190529a
922[13.3 Ch
950 13.8 Wn
RW Sgr
190810a
895 9.7 Bw
937 9.4 Pt
TY Aql
190907
866 10.8 Bw
937 10.2 Pt
S Lyr
190925
922 13 3 Ch
950[13.3 Wn
X Lyr
190926
937 9.0 Pt
RS Lyr
190933a
893 13.9 Bw
922[13.4 Ch
950[13.4 Bw
RU Lyr
190941
928 13.3 L
945 12.3 L
949 11.8 Md
U Dra
190967
894 11.9 Bw
918 9.6 Ch
928 9.2 L
937 9.1 Pt
944 9.1 L
950 9.4 Bw
W Aql
191007
866 9.4 Bw
937 10 7 Pt
T Sgr
191017
918 8.9 Ch
932 8.1 L
937 8.4 Pt

T Sgr
191017
945 7.8 L
R Sgr
191019
918 7.7 Ch
932 7.9 L
937 8.2 Pt
945 7.9 L
RY Sgr
191033
886 6.4 Dr
889 6.0 Ht
889 6.0 Bl
891 6.2 Kd
904 6.3 Bl
906 6.9 Ht
910 7.1 Dr
914 6 5 Ht
914 6.0 Bl
916 6.3 Dr
918 6.2 Ch
923 6.2 Dr
927 6.4 L
932 6.4 L
934 6.4 Dr
936 6.7 Dr
940 6.5 Pt
941 6.6 Pt
942 6.7 L
943 6.8 L
945 6.8 L
946 7.0 L
TY Sgr
191124
887 15.0 Dr
890[13 0 Bl
914[13.0 Bl
S Sgr
191319a
889[13.5 Bl
914 12.0 Bl
932 10.4 L
945 9.7 L
SW Sgr
191331
886 10.6 Dr
889 10.8 Bl
899 10.4 Dr
904 10.0 Bl
910 10.5 Dr
915 10.1 Bl
923 10.6 Dr
936 10.8 Dr
TZ Cyg
191350
937 10.1 Pt
U Lyr
191637
937 11.2 Pt

Variable Star Observations Received During December, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
AF Cyg	RT Cyg	RR Aql	R Cap	R Del	U Mic
192745	194048	*195203*	*200514*	201008	*202240*
920 7.4 Ah	950 7.2 B	922 9.5 Ch	937 11.1 Pt	944 12.8 B	904 11.6 Bl
922 7.4 Ah	TU Cyg	924 9.6 B	939 10.9 Ch	RT Cap	910 11.9 Dr
924 7.1 Ah	194348	928 9.3 L	945 11.3 L	*201121*	915 12.5 Bl
925 7.2 Ah	916 9 7 Ch	937 9.5 Pt	S Aql	889 7.3 Kd	923 12.5 Dr
927 7.0 Ah	928 10.5 L	937 9.3 Tf	200715a	920 7.5 Kd	936 12.6 Dr
935 7.2 Ah	937 11.4 Pt	943 9 3 Tf	918 11.2 Ch	938 7.6 Kd	Z Del
936 7.2 Ah	945 11.8 L	945 9.2 L	936 9.2 Ch	941 7.6 Kd	202817
937 7.0 Ah	950 11.5 B	RS Aql	936 9.2 Be	946 7.7 Kd	925 9.6 B
938 6.9 Ah	X Aql	*195308*	936 9.3 An	SX Cyg	932 9.6 L
939 6.9 Ah	194604	940[13.8 Ch	937 9.6 Pt	201130	937 10.0 Pt
TY Cyg	922 9.7 Tf	Nov Cyg	RW Aql	944 13 5 B	939 10.2 Ch
192928	922 9.7 Ch	195553	200715b	950 13.0 Wn	ST Cyg
922[13.0 Ch	924 9.9 B	923[12.9 Ch	937 9.1 Pt	950 13.1 Bw	202954
RT Aql	928 10.1 L	RR Tel	R Tel	RT Sgr	937 13.9 Pt
193311	935 10.1 Sf	*195656*	*200747*	*201139*	941 14.1 L
922 10.8 Ch	937 10.4 Pt	889[12.6 Ht	890 14.0 Bl	886 6.8 Dr	944 13.6 B
923 10.6 Ah	945 11.0 L	906[12.6 Ht	913 12.9 Dw	889 7.0 Bl	V Vul
925 10.5 B	947 10.4 Sf	914[12.6 Ht	913 13.0 Dr	899 6.9 Dr	203226
928 10.4 L	948 11.0 Md	Z Cyg	915 12.7 Bl	904 7.1 Bl	937 8.8 Pt
937 11.6 Pt	x Cyg	195849	934 12.5 Dr	910 7.2 Dr	R Mic
945 11.0 L	194632	923 12.5 Ch	RU Aql	915 7.4 Bl	*203429*
R Cyg	889 8.6 Kd	937 12.7 Pt	200812	923 7.6 Dr	889 12.5 Bl
193449	890 8.8 Kd	946 12.9 L	928 11.0 L	936 8.2 Dr	915 13.3 Bl
922 11.6 Ch	920 9 7 Ah	950 12.8 B	935 10.7 B	WX Cyg	Y Del
937 12.0 Pt	920 9.9 Bc	S Tel	936 10.8 Ch	201437b	203611
941 12.0 Jo	922 9.9 Ah	*195855*	946 9.9 L	928 12.3 L	941 13.8 L
950 12.0 B	922 9.9 Ch	889 12.8 Ht	W Cap	932 12.6 Lg	944 13.8 B
RV Aql	937 10.2 Pt	890 13.1 Bl	*200822*	936 12.5 Ch	S Del
193509	951 11.5 B	914 12.8 Ht	890[12.8 Bl	937 12.5 Pt	203816
922[12.0 Ch	S Pav	915 13.1 Bl	915 13.3 Bl	944 12 2 B	920 9.0 Lj
941 12.3 L	*194659*	SY Aql	Z Aql	944 12.4 L	925 8.7 B
T Pav	886 8.0 Dr	200212	*200906*	U Cyg	927 9.1 Lj
193972	910 8.5 Dr	925 9.9 B	866 9.9 Bw	201647	931 9.1 Lj
890 13.8 Bl	923 8.6 Dr	928 9 5 L	893 10.4 Bw	922 8.1 Ah	933 9.2 Lj
906[13.2 Ht	936 8.7 Dr	936 9.7 Ch	937 12.7 Pt	923 8.1 Ah	935 9.4 Lj
910 13.0 Dr	RR Sgr	936 9.7 Be	944[13.3 B	923 7.6 Ch	937 9.3 Pt
915 13.0 Bl	*194929*	936 9.6 An	R Sge	924 8.1 Ah	939 9.6 Lj
920 13.0 Dr	886 11.8 Dr	937 9.2 Pt	200916	925 8.2 Ah	941 9.7 Lj
934 12.2 Dr	889 10.5 Bl	946 9.5 L	936 8.6 An	927 8.2 Ah	V Cyg
936 12.1 Dr	904 12.1 Bl	950 10.0 Wn	936 8.7 Be	935 8.3 Ah	203847
949 11.6 Dw	915 13.0 Bl	BU Cyg	RS Cyg	935 7.8 B	923 10.6 Ch
RT Cyg	916 13.0 Dr	200250	200938	937 8.4 Ah	928 9.5 L
194048	934 13.5 Dr	927[12.5 Lj	918 7.2 Ch	937 8.8 Sf	937 10.9 Pt
916 8 2 Ch	RU Sgr	933[12.5 Lj	923 7.2 Ch	937 8.0 Wd	937 10.4 Sf
920 8.1 Ah	*195142*	935 12.5 Lj	928 7.5 L	937 8.2 Pt	940 10.8 Ch
922 7.7 Ah	886 10 0 Dr	939 12.4 Lj	932 7 2 Lg	938 8.6 Fd	945 10.9 L
923 7.5 Ah	889 10.4 Ht	940 12.4 Lj	941 7.3 Jo	938 8.2 Ah	Y Aqr
924 7.5 Ah	889 10.1 Bl	942 12.2 Lj	941 6.8 Al	939 8 2 Ah	*203005*
925 7.3 Ah	904 11.1 Bl	S Cyg	944 7.2 L	941 8.0 Al	918 9.8 Ch
927 7.3 Ah	906 11.3 Ht	200357	945 7.4 Gb	941 7.8 Jo	936 10.6 Be
935 7.2 Ah	910 11.7 Dr	923[13.1 Ch	947 7.3 Jo	950 8.4 Wd	936 10.5 An
936 7.0 Ah	914 11.8 Ht	939 13.3 Br	950 7.2 Gb	951 8 6 Fd	937 9.9 Pt
937 7.1 Ah	915 11.9 Bl	941 13.2 L	951 7.1 Gb	954 9.2 Sf	T Del
937 7.2 Pt	923 12.5 Dr	942[12 8 Mb	954 7.3 Al	954 8.0 Al	204016
938 7.1 Ah	936 12.4 Dr	949[11.7 Md	R Del	U Mic	935[13.5 B
939 7.2 Ah	RR Aql	R Cap	201008	*202240*	936[13.3 An
941 7.2 Jo	*195203*	*200514*	932 12.5 L	886 10.7 Dr	938[13.3 Ch
949 7.9 Md	922 9.6 Tf	932 11.0 L	937 12.9 Pt	889 10.9 Bl	941[12.9 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1929.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

V AQR
204102
928 8.2 L
937 8.5 Pt
945 8.1 L
947 8.7 Md

W AQR
204104
941 13.8 L

U CAP
204215
890[13.9 Bl
915 13.3 Bl
928 12.4 L
945 11.5 L

V DEL
204318
935[13.9 Br
940[13.1 Ch

T AQR
204405
936 11.6 An
936 11.7 Be
937 11.8 Pt

RZ CYG
204846
937 11.9 Pt
941 11.8 B

S IND
204954
886 12.0 Dr
889 11.6 Bl
889 12.0 Ht
904 12.4 Bl
906 12.2 Ht
910 12.8 Dr
914 13.3 Ht
915 12.8 Bl
920 13.3 Dr
936 13.8 Dr

X DEL
205017
940[13.2 Ch
941[13.5 B

RR CAP
205627
886 13.1 Dr
910 13.8 Dr
923[13.6 Dr

T OCT
205782
913 10.0 Dw
913 9.6 Dr
920 9.2 Dr
934 9.3 Dr

R VUL
205923a
920 8.1 Ah
922 7.9 Ah
924 7.7 Ah

R VUL
205923a
925 8.1 Ah
927 7.8 Ah
929 8.0 Ah
936 8.4 Ah
937 8.7 Ah
937 8.5 Pt
938 8.7 Ah
939 8.9 Ah
939 8.5 Ch
941 9.2 B
941 8.5 Jo
943 8.5 Md

V CAP
210124
890[13.3 Bl
915[13.5 Bl
923[12.9 Dr
936[13.2 Dr

TW CYG
210129
942 13.8 L
944 13.7 B

X CAP
210221
889 11.4 Bl
904 11.5 Bl
915 11.9 Bl

RS AQR
210504
942 13.2 L

Z CAP
210516
937 13.6 Pt

R EQU
210812
942 12.9 L

T CEP
210868
918 6.4 Ch
920 6.2 Ah
922 6.1 Ah
924 6.1 Ah
925 6.2 Ah
927 5.9 Ah
929 5.9 Ah
935 6.0 Ah
936 6.1 Ah
937 6.0 Ah
938 6.1 Ah
938 6.1 Pt
938 5.9 Fd
939 6.1 Ah
940 6.4 Ch
941 6.0 Jo
946 5.6 Fd
947 6.3 Jo
950 6.0 B
950 6.6 Wd

T CEP
210868
951 6.6 Fd

RR AQR
210903
938 12.6 Pt
942 14.1 L

Y PAV
211570
889 6.1 Ht
906 6.5 Ht
914 6.0 Ht

X PEG
211614
932 10.1 L
938 10.9 Pt
944 10.7 B
945 10.0 L

T CAP
211615
890[13.2 Bl
915[13.2 Bl
939[12.8 Ch

S MIC
212030
886 10.3 Dr
889 10.0 Bl
899 10.8 Dr
904 10.9 Bl
910 11.1 Dr
916 12.0 Bl
923 12.6 Dr
936 13.3 Dr

Y CAP
212814
890[13.1 Bl
916[13.2 Bl
939[13.2 Ch
942 14.5 L

W CYG
213244
889 6.5 Kd
890 6.4 Kd
900 6.6 Kd
905 6.5 Kd
916 6.6 Kd
918 6.6 Kd
920 6.6 Kd
921 6.6 Kd
922 6.6 Tf
927 6.2 Tf
927 6.0 L
930 6.1 Tf
932 6.1 Tf
934 6.6 Kd
938 6.6 Kd
938 6.2 Tf
941 6.2 Tf
941 6.1 L
941 6.6 Kd

W CYG
213244
943 6.3 Tf
945 6.2 Tf
946 6.6 Kd
949 6.6 Kd

S CEP
213678
934 11.1 Mb
938 11.2 Pt
950 11.4 B
954 11.6 Mb

RU CYG
213753
893 10.2 Bw
920 9.0 Ah
922 8.8 Ah
924 8.8 Ah
938 8.5 Ah
938 8.4 Pt
939 8.6 Ah
949 8.4 Bw

RV CYG
213937
938 6.3 Pt

RR PEG
204024
939[13.4 Ch
950 13.5 B

R GRU
214247
890[13.7 Bl
906[12.9 Ht
913 14.4 Dw
913 14.6 Dr
916[13.7 Bl
936 13.7 Dr

V PEG
215605
939[13.8 Ch

U AQR
215717
938 13.0 Pt
940 12.6 Ch
942 12.7 L

RT PEG
215934
938 11.7 Pt

RZ PEG
220133b
938 10.8 Pt
942 10.0 L

RS PEG
220714
942 13.3 L

R PSA
221230
886 9.6 Dr
899 8.5 Dr
910 9.2 Dr
914 9.3 Ht
920 9.2 Dr
934 9.7 Dr
939 10.0 Dr
946 9.6 Kd

R PSA
221230
920 9.6 Dr
934 10.1 Dr

S GRU
221048
886 12.7 Dr
906[12.8 Ht
910 13.2 Dr
914[12.8 Ht
920 13.9 Dr

RV PEG
222129
934[11.4 Mb
939[13.3 Ch
942 14.3 L
954[12.0 Mb

S LAC
222439
932 12.1 L
935 11.3 An
938 12.3 Pt
941 12.8 Al

R IND
222867
886[13.8 Dr
890[13.5 Bl
908[13.5 Ht
913 14.9 Dr
913 14.6 Dw
916 13.5 Bl
936 13.4 Dr

T TUC
223462
882 9.1 Dr
899 8.4 Dr
908 8.2 Ht
910 8.3 Dr
914 8.2 Ht
920 8.3 Dr
934 8.6 Dr

R LAC
223841
922 9.2 Tf
932 9.1 L
938 9.1 Pt
939 9.5 Ch
943 9.3 Sf
946 9.5 L
952 9.7 Sf

RW PEG
225914
952 11.4 L
938 11.4 Pt
939 11.6 Ch

R PEG
230110
940 11.6 Ch

V CAS
230759
938 11.8 Pt
940 11.8 Ch
943 11.8 Mb

W PEG
231425
932 10.9 L
941 11.2 Al
947 11.8 Lg

S PEG
231508
938 13.2 Pt
942 13.4 L

V PHE
232746
886 9.3 Dr
899 8.5 Dr
908 9.2 Ht
910 9.2 Dr
914 9.3 Ht
920 9.2 Dr
934 9.7 Dr

Z AND
232848
931 10.3 Mb
931 10.3 Cr
934 10.2 Mb
938 10.5 Pt
942 10.7 Bw
942 10.4 Mb
951 10.5 Bw
954 10.3 Mb

ST AND
233335
920 10.9 Lj
927 11.1 Lj
931 10.6 Al
935 11.3 Lj
935 11.0 Al
938 10.9 Pt
939 11.3 Lj
941 11.3 Lj
947 10.7 Lg

R AQR
233815
889 8.5 Bl
892 8.7 Kd
904 8.5 B
906 8.4 Ht
914 8.6 Ht
916 8.5 Bl
918 8.6 Ch
922 8.8 Tf
932 8.7 L
935 8.6 An
937 8.7 Tf
938 8.6 Tf
938 8.9 Pt
941 8.7 Tf

Variable Star Observations Received During December, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R Aqr	RR Cas	V Cet	R Cas	Z Peg	Y Cas
233815	235053	*235209*	235350	235525	235855
941 8.7 Al	934 8.0 Mb	890[13.6 Bl	936 8.0 Ah	935 12.9 Lj	941 10.8 Ch
942 8.6 Kd	954 7.1 Mb	916[13.6 Bl	937 7.8 Ah	938 13.0 Pt	942 11.6 L
943 8.3 Tf	R Phe	R Tuc	938 7.8 Ah	939 12.9 Lj	954 11.4 Mb
945 8.9 Tf	*235150*	*235265*	939 7.7 Ah	940 12.9 Lj	SV And
946 8.6 L	886 13.8 Dr	887 15.2 Dr	941 7.4 Ch	945 13.1 L	235939
949 8.6 Kd	910 13.6 Dr	887 15.2 Dw	Z Peg	W Cet	938 13.2 Pt
Z Cas	920 13.3 Dr	913 14.9 Dr	235525	*235715*	945[13.1 Bw
233956	936 12.1 Dr	913 15.0 Dw	920 12.9 Lj	935 9.2 An	
941 11.0 Ch	949 11.3 Dw	936 14.3 Dr	927 12.9 Lj		
942 11.4 L					

Rapidly Varying Irregular Variables.

005840 RX Andromedae—

Star J.D.	Est.Obs.	J.D.	Est.Obs.
5934.6	13.2 Br	5940.7	11.6 Pt
5935.6	12.9 Br	5941.7	11.7 Pt
5936.4	13.1 An	5942.7	11.9 Pt
5936.6	13.0 Br	5944.7	12.4 Pt
5937.7	11.5 Pt	5945.7[	12.4 Pt
5938.7	11.5 Pt	5946.7[	12.4 Pt
5939.6	11.3 Br	5951.7[	12.4 Pt
5939.7	11.5 Pt		

010884 RU Cephei—

5930.7	9.1 L	5943.3	8.8 L

060547 SS Aurigae—

5894.7[	13.6 Bw	5940.7	15.0 L
5913.7[	13.3 Bw	5941.3	14.4 L
5917.4	14.5 L	5942.7	14.7 L
5922.2[	13.3 Ch	5943.7	14.8 L
5925.6[	13.3 Bw	5944.7	14.9 L
5927.3[	13.3 L	5945.7	14.8 L
5928.6	14.8 L	5946.9[	12.6 Pt
5929.7[	14.5 L	5949.9[	12.6 Pt
5931.7[	12.4 L	5950.6[	13.7 B
5932.7[	14.0 Lg	5951.7[	12.4 Pt
5935.7[	13.3 Lg	5952.8[	12 6 Pt
5936.1[	11.6 Ch	5957.7[	13.0 Bw
5937.7	14.5 L		

074922 U Geminorum—

5914.7[	13.7 Bw	5937.7	13.9 Lg
5917.6	14.1 L	5938.7[	12.3 Pt
5926.6	13.9 L	5940.6	14.0 L
5927.4	14.0 Ch	5941.6	14.0 L
5928.4	14.0 Ch	5942.7	14 0 L
5928.7	14.0 L	5943.7	13.9 L
5929.7	14.0 L	5944.7	14.0 L
5931.7[	13.7 L	5945.4	14.0 L
5932.7	13.9 Lg	5945.7	14.1 L
5933.7[	13.3 L	5946.4[	13.7 L

081473 Z Camelopardalis—

5917.4	12.9 L	5937.7	12.2 L
5927.3	11.4 L	5940.7	12.4 L
5928.3	11.5 L	5941.3	13.1 L
5928.4	10.8 Ch	5941.7	12.9 L
5929.6	11.8 L	5942.2	13.1 L
5931.7	12.5 L	5943.3	13.1 L
5933.7	12.5 L	5943.7	12.5 L
5935.4	12.2 An	5944.2	13.0 L

081473 Z Camelopardalis—

5945.4	11.8 L	5945.7	11.4 L
5945.4	11.8 L	5946.2	11.0 L

094512 X Leonis—

5917.6	13.8 L	5933.7	12.2 L
5926.6[	14.2 L	5937.6	12.2 L
5928.7[	13.8 L	5940.6[	14.2 L
5929.7[	13.8 L	5941.6[	14.2 L
5931.6	12.3 L	5944.7[	14.2 L
5932.6	12.3 L	5945.7[	14.7 L

202946 SZ Cygni—

5935.7	9.4 Pt	5944.7	9.0 Pt
5937.7	9.6 Pt	5945.7	8.8 Pt
5938.7	9.6 Pt	5946.7	8.9 Pt
5939.7	9.6 Pt	5950.7	9.0 Pt
5940.7	9.6 Pt	5951.7	9.1 Pt
5941.7	9.6 Pt	5952.7	9.6 Pt
5942.7	9.4 Pt		

213843 SS Cygni—

5917.3	11.9 L	5934.5	11.1 Mb
5919.1	11.7 Ch	5934.6	11.8 Br
5920.4	11.7 Lj	5935.2	11.6 Lj
5920.5	11.4 Ah	5935.4	11.6 An
5920.7	10.6 Bc	5935.6	11.7 Br
5921.7	9.4 Bc	5935.7	11.5 Pt
5922.2	8.8 Ch	5935.7	11.6 Lg
5922.4	8.5 Tf	5936.1	11.7 Ch
5922.4	9.0 Ah	5936.2	11.8 Ah
5923.3	8.7 Ah	5936.3	11.8 An
5924.3	8.5 Ah	5936.3	11.6 Be
5925.4	8.9 Ah	5936.6	11.7 Br
5925.6	9.0 B	5937.3	11.8 Ah
5927.1	9.4 Ch	5937.7	11.5 Pt
5927.2	9.6 L	5937.7	11.9 Lg
5927.3	9.2 Lj	5938.3	11.8 Ah
5927.3	9.4 Ah	5938.7	11.9 Fd
5928.3	9.6 L	5938.7	11.4 Pt
5929.2	10.3 Ah	5939.2	11.8 Lj
5929.7	9.9 Bc	5939.3	11.9 Ah
5931.3	10.8 Lj	5939.6	11.6 Br
5931.6	11.0 Al	5939.7	11.6 Pt
5932.3	11.1 L	5939.8	11.8 Mb
5932.4	11.1 Lj	5940.1	11.6 Ch
5932.7	10.3 Lg	5940.2	11.6 Lj
5933.2	11.0 Lj	5940.3	11.8 Lj

213843 SS CYGNI—

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
	5940.7	11.7 Pt	5942.2	11.7 L
	5941.2	11.9 Lj	5942.5	11.9 Mb
	5941.3	11.6 L	5942.7	11.7 Pt
	5941.6	11.6 B	5943.3	12.0 L
	5941.6	11.5 Al	5943.8	11.5 Md
	5941.6	11.5 Jo	5944.4	12.0 L
	5941.7	11.7 Pt	5944.7	11.7 Pt
	5942.2	11.8 Lj		

213843 SS CYGNI—

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
	5945.4	12.0 L	5949.7	11.9 Lg
	5945.7	11.7 Pt	5950.6	11.5 B
	5945.7	11.7 Ma	5950.7	11.7 Pt
	5946.2	11.3 L	5951.6	11.9 Fd
	5946.4	11.7 L	5951.7	11.7 Pt
	5946.7	11.7 Pt	5952.7	11.7 Pt
	5947.8	11.7 Md	5954.5	11.9 Mb
			5954.6	12.0 Al

MONTHLY SUMMARY FOR DECEMBER, 1929.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	32	215	Hollis	Ho	4	6
Allen, P. R.	Al	19	27	Houghton	Ht	59	114
Ancarani	An	26	27	Jones	Jo	27	40
Baldwin	Bl	92	204	Kanamori	Km	1	7
Bigelow	Bw	26	43	Kanda	Kd	17	100
Boutell	BL	9	58	Lacchini	L	142	325
Bouton	B	47	49	Logan	Lg	14	19
Brocchi	Br	12	18	Leiner	Lj	14	84
Brown, A. N.	Bn	2	2	Marsh	Ma	8	8
Buckstaff	Bc	3	8	McBride	Mb	14	24
Campbell	C	4	6	Millard	Md	9	11
Carl	Cr	3	4	Peltier	Pt	164	248
Chandra	Ch	164	180	Smith, F. W.	Sf	11	21
Dartayet	Dr	85	274	Taffara	Tf	16	57
Dawson	Dw	26	35	Webb	Wd	2	3
Ford	Fd	10	18	Wilson	Wn	4	4
Gaebler	Gb	3	5				
				Totals		34	405	2250

He was a faithful servant and took great pride in his official position as Treasurer of the Association and of the E. C. Pickering Memorial Fund. At a special meeting of the Council, held at Cambridge on December 31, Dr. W. J. Fisher was elected Treasurer to fill the unexpired term of Mr. Jordan.

Ere this report is in print, members of the Association should have received the new Library Catalogue, Variable Comments, Vol. II, No. 4, and two circulars dealing with the proposed change in the Calendar. The reprint of observations for 1929 will be ready for distribution early in February.

LEON CAMPBELL, Recording Secretary.

January 10, 1930.

OCCULTATIONS

Occultations Visible at Omaha and Vicinity.

(Disappearances Only)

Date 1930		Star	Mag.	G.C.T. h m	*a* m	*b* m	P °
March	4	263 B. Piscium	6.4	2 9	—0.4	+2.0	59
	6	54 Arietis	6.5	3 8	—0.8	+1.3	64
	9	415 B. Tauri	6.1	0 43	—1.8	+1.2	59
	10	47 Geminorum	5.6	3 42	—1.1	—1.8	141
	10	134 B. Geminorum	6.5	6 18	—0.6	+0.6	107
	11	λ Cancri	5.9	6 27	Grazing contact		187
	12	90 H.[1] Cancri	6.1	0 37	—0.9	—0.7	73

The approximate times for observers within 300 miles of Omaha can be found by using the constants a and b, given in the table, according to the formula

$$\text{G.C.T.} = \text{Predicted G.C.T.} + a\Delta\lambda + b\Delta\phi,$$

$\Delta\lambda$ and $\Delta\phi$ in this case being obtained by using the longitude (96°.0) and latitude (41°.3) of Omaha, and subtracting these, respectively, from the longitude and latitude of the place.

WM. CLETUS DOYLE, S. J.

Creighton University Observatory.

Reductions of Occultations (Immersions) Observed During 1929 at Leonia, New Jersey.—The observations were made at my observatory, Lat. 40° 51′ 50″ N, Long. 73° 59′ 19″ W, with a 4-inch Clark refractor, stop watch, and Frodsham chronometer. Error and rate of time piece determined by Arlington time signals. Formulas used in the reduction are those by R. T. A. Innes, *Ast. Jour.*, No. 835, as modified by the Yale University Observatory. The "seeing" for No. 1 was very good; for Nos. 2, 3, 5, 9, 10, and 11, good; and for the remainder poor. Nos. 1, 2, 3, 5, 8, and 9 were observed at the dark limb; the remainder at the light limb.

IMMERSIONS

No.	Star	R.A. h m s	Dec. ° ′ ″	Date 1929	G.C.T. h m s	$\chi - \rho$ ° ′	$\sigma' - \sigma$
1	145 B. Ari	3 0 42.97	+15 34 52.7	Jan. 19	23 57 36.7	+13 30	—2.7
2	14 Tau	3 39 40.16	+19 26 33.5	Feb. 16	22 57 40.1	—20 7	—1.2
3	300 B. Tau	4 41 24.96	+23 30 3.1	Feb. 18	0 21 53.9	—22 16	—0.4
4	τ Sgr	19 2 30.42	—27 46 37.1	Apr. 2	10 36 27.5	+36 55	+4.0
5	150 B. Lib	15 27 39.81	—19 55 34.2	Jun. 19	3 35 3.1	—19 38	—0.8
6	κ Tau	4 21 7.71	+22 8 2.7	Jul. 4	8 29 23.0	+22 52	—0.4
7	67 Tau	4 21 10.85	+22 2 24.8	Jul. 4	8 34 46.0	+48 19	+5.1
8	ω Sgr	19 51 32.25	—26 29 22.2	Sept. 14	2 22 19.4	—53 28	—0.5
9	X Sgr	17 43 6.89	—27 48 28.4	Oct. 9	0 47 34.2	+ 0 46	+0.3
10	A Tau	4 0 32.72	+21 53 36.0	Oct. 21	3 51 39.6	+ 7 19	+1.5
11	39 Tau	4 1 10.91	+21 49 21.7	Oct. 21	4 14 50.3	+40 46	+1.6

Leonia, N. J., January 17, 1930.

J. ERNEST G. YALDEN.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1930		Star	Mag.	IMMERSION Washington C.T. h m	IMMERSION a m	IMMERSION b m	IMMERSION Angle E from N °	EMERSION Washington C.T. h m	EMERSION a m	EMERSION b m	EMERSION Angle E from N °
Mar.	5	54 Ari	6.5	22 11	—0.3	—0.3	58	23 4	+0.4	—1.2	273
	6	32 Tau	5.8	18 51	—1.9	—1.7	108	19 57	—1.6	—1.2	219
	8	415 B.Tau	6.1	20 10	—2.0	+0.4	70	21 23	—1.3	—1.9	293
	9	47 Gem.	5.6	22 58	—0.7	—1.9	123	0 1	—0.9	—1.1	266
	10	134 B.Gem	6.5	1 22	—0.3	—1.0	85	2 13	+0.4	—1.6	304
	11	λ Cnc	5.9	1 18	+0.1	—2.3	146	2 6	—0.6	—1.0	258
	11	90 H.^{5} Cnc	6.1	19 51	—1.8	+1.1	85	20 58	—1.5	—1.8	320
	15	91 G.Vir	6.5	20 27	—0.1	—1.1	158	21 17	—0.9	+1.4	267
	22	58 G.Sgr	6.1	2 46	—2.1	+2.7	52	3 38	—0.3	—0.7	329

The quantities in the columns a and b are given for the purpose of making these predictions useful for any place within 200 or 300 miles of Washington. The procedure is as follows: Subtract the longitude of Washington (77°.1) from the longitude of the place in question; multiply the result, taking the signs into ac-

count, by the quantity under *a* for the star to be observed; similarly, with the latitude (38°9) using *b*; apply the sum of the products, with its proper sign, to the Washington C.T., and obtain the predicted Civil Time for the phenomenon at the place of observation.

METEOR NOTES

By CHARLES P. OLIVIER.

Due to moonlight and bad weather during critical periods of the last three months of 1929, many of our best observers had little or nothing to report. Also reports on some work that was done have not been received here as yet. These circumstances give us fewer meteors to record than has been the case for a long time. The annual report is still held up, as we wish our observers in the Southern Hemisphere to have time to send in their last results. It should appear next month.

The list of radiants given herein, Nos. 2113 to 2139 inclusive, is entirely due to our Texas group, and the radiants are deduced from observations made from August 5 to September 1. Large numbers of their maps, as well as those of many other observers, still await complete study before the radiants on them are published.

A brilliant fireball appeared on January 3 at about 5:55 A.M., E.S.T., and was seen over Ohio and the western part of Pennsylvania, as well as adjoining states. Notices of this appeared the same day in the papers, and at least one request for observations was published. But so far not one observation of the least value by an eye witness has been sent in here, though a few indirect reports have arrived. This object appeared over a densely populated area and it is too bad that nothing authentic can be learned about it.

After some correspondence, and assuring ourselves that further inquiry would lead to no appreciably fuller results, the article by Mr. C. S. Cole, observer for the Weather Bureau at Little Rock, Arkansas, on the fireball of November 8, 1929, is herein published. The writer adds a few remarks at the end. This article was sent to the A.M.S. by the U. S. Weather Bureau and is published here with Mr. Cole's consent. It would be most useful to science if other Weather Bureau observers would make the effort to collect observations when a great fireball appears over their territory, as he has done.

We welcome as a new member Mr. James J. Benner, 21 Fillier Street, Berea, Ohio. An urgent request is hereby given to all our members to send in their 1929 results at once for inclusion in the annual report. Also members of the A.A.V.S.O., who kindly send us their telescopic meteor observations, are asked to report promptly, for the same reason.

Our member, Mr. R. A. McIntosh, has been made director of the Section for the Observation of Meteors of the New Zealand Astronomical Society. In the *Transactions of the N. Z. Institute*, Vol. 60, 1929, he has published a splendid report on the work done there in 1927 and 1928. This contains 17 pages of text and follows the general form of our own M series of publications. In the November *Monthly Notices*, just to hand, he has two excellent articles on the Halley Comet meteors and the Orionids. In each case his results confirm those of the writer that both streams have radiants which are in daily motion. All our members should try to get copies of these articles. Mr. McIntosh is to be heartily

congratulated on the success of the work done in New Zealand on meteors in which he is the pioneer.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Observer
Aug. 23	11:30	12:00	30	1	0.3	2.0	—	C. B. Ford
Oct. 18	12:30	13:30	60	1	0.6	1.0	1.7	
Nov. 15	14:00	14:30	30	1	0.4	2.0	—	
Casuals				3				
Nov. 25	6:30	8:40	130	13	0.7	6.0	8.6	V. Anyzeski
Casuals				6				
Sept. 12	11:45	15:15	210	30	0.6	8.6	—	*
Casuals				15				J. H. Logan
Nov. 15?	12:40	13:48	68	11	0.4	—	—	**
Casuals				12				F. W. Smith
Casuals				11				Millard Bennett
Casuals				3				H. B. Ranson
Dec. 8	10:10	12:10	120	11	0.8	5.5	—	***

*J. H. Logan and another; S. S. "Dixie."
**Boys Rod and Gun Club, La Crosse, Wis. No. of observers not given.
***Miss L. B. Allen and Miss E. Hatterstein.

RADIANTS BY J. H. LOGAN.

A.M.S. No.	G.M.T. 1929		α °	δ °	Meteors	Wt.	Remarks
2113	Aug.	10.77	44	+55.5	8+	Good	Perseids
2114		10.77	295	+59	3	Fair	
2115		10.77	297.5	— 5	5—	Good	
2116		10.77	342	—13	3	Fair	
2117		10.77	356	+ 6	5—	Fair	
2118	Sept.	1.76	7	+49	6	Good	
2119		1.76	28	+ 1	5	Good	
2120		1.76	31	+33	3	Fair	
2121		1.76	47	+69	3-5	Good	
2122			357	+29	3	Fair	

RADIANTS BY ROBERT BROWN.

2123	Aug.	7.70	311	+ 6	3	Fair	Combine
2124		10 81	312	+ 8	4	Fair	

RADIANTS BY STERLING BUNCH.

2125	Aug.	8.73	41	+55		Good	Perseids; large area
2126		8.73	313	+12	6—	Fair	
2127		8.73	316	+47	5	Good	
2128		8.73	330	+39	7	Good	

RADIANTS BY O. E. MONNIG.

2129	Aug.	6.76	39	+59	2+	Poor	Perseids
2130		5 74	272	+44	5-6	Good	
2131		10.81	289	+13.5	3-4	Fair	
2132		5.74	300	+50	6	Good	
2133		5.74	302	+58	4	Good	1 also Aug. 6
2134		5.74	317	+18	3	Fair	1 also Aug. 6
2135		11.7c	322	— 8	4	Fair	2 on Aug. 10; 2 Aug. 12
2136		6.76	337.5	—10	6	Fair	1 also Aug. 5

RADIANTS BY BLAKNEY SANDERS.

2137	Aug.	10.74	27	—18	3	Fair	
2138		10.74	39	+56.5	9	Good	Perseids
2139		10.74	322	— 1	3	Fair	

LARGE METEOR OF NOVEMBER 8, 1929

By H. S. Cole, *Meteorologist.*

A large meteor of unusual brilliance was observed by many persons in Arkansas and surrounding states at 9:15 P.M. or slightly later, November 8, 1929. The writer was in a hotel at Calico Rock, Arkansas, and knew nothing of it until the next day, but a number of reports of the meteor have been received at the Weather Bureau Office.

None of those who observed the meteor made any effort to locate it by stars, but seven of them give the direction in which it was last seen. The ones giving

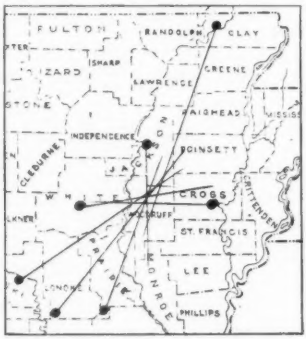


FIGURE 1.

Dots indicate location of observers. Lines indicate directions in which meteor was last seen.

definite reports of direction were located at Belcher Lake, in extreme southwestern Prairie County, Corning, in Clay County, England in extreme southwestern Lonoke County, Little Rock, in Pulaski County, Newport, in Jackson County, Searcy, in White County, and Wynne, in Cross County. These locations are indicated on the accompanying chart by dots, the directions in which the meteor was last seen by lines from the dots.

Most of the observers are not accustomed to the use of technical terms, but after charting their statements as best we could it was found that nearly all of the lines intersected in northern Woodruff and southern Jackson counties. The center of these intersections is a few miles north of Patterson (formerly Jelks). When the meteor disappeared it was seen north-northeast of Little Rock, east of Searcy, south of Newport, west of south of Corning, west of Wynne, east of north of Belcher Lake, and northeast of England.

From the reports it seems that the meteor moved nearly north-northeast and fell rapidly toward the earth. Mr. Ben J. Field, who was at Belcher Lake, saw the meteor northeast of him, apparently moving south of east and falling toward the earth. Mr. Sharman H. Atkinson at Little Rock saw it east of him, apparently moving north-northeast and falling toward the earth. Mr. Albert G. Sexton, Jr., at England, who was between the two just named, saw the meteor moving directly overhead in a north-northeasterly direction and falling toward the ground. His statement follows: "The meteor fell northeast, but more north than east. It seemed closer than it was. It was about 9:15 P.M. The meteor seemed to curve

in an arch over my head, starting in the southwest and ending in the northeast. When I last saw it, it seemed to explode, but I heard no sound."

Mr. Atkinson gives the elevation of the meteor when it disappeared as 30° above the surface, Mr. Field gives it as 10°. Mr. Atkinson was on high ground, Mr. Field on low ground which partly accounts for the difference in their estimates, and their not being accustomed to estimating angles in the sky accounts for the remainder of the difference. Taking the lowest estimate and the distance as 50 miles, the meteor must have disappeared eight miles or more above the surface. The distance was probably nearer 60 miles than 50 and the elevation more than 10°, making the point at which it disappeared considerably more than eight miles above the ground.

Some of the observers mention the slow movement of the meteor across the sky, most of them mention the downward movement. Both of these seem to indicate that the meteor was falling rapidly toward the earth.

Estimates of the size of the meteor vary from the size of the moon to one-fourth that size. There must have been a large mass of blazing gases surrounding the nucleus. The piece of solid matter, however, must have been small or it would not have burned out before reaching the earth.

The meteor must have been intensely hot, as indicated by the predominance of blue light. Nearly all who described it mentioned the blue colors, some mentioning other colors, but the blue was most prominent. Mr. Sexton states that "the ground looked blue. The meteor looked all colors of the rainbow." The light must have been intense, as some observers said it made things as light as day. Some said it was light enough to read a newspaper, one young man stating that he tried it out, reading a newspaper by the light. One mentioned a train of sparks following it, the length of the train being several times the width of the meteor. Several gave the time it was in sight as two or three seconds.

Some think the meteor burned out and disappeared in a shower of sparks, others think it exploded, pieces going in all directions. The evidence is conclusive that its course as a meteor ended before it reached the earth. The sparks, so called, must have been pieces of white hot metal of some size to have been seen 50 miles or more. These small pieces probably fell to the earth, but they fell in a sparsely settled section where they may never be seen, and if seen they will probably not be recognized as a part of the meteor.

NOTE BY C. P. OLIVIER: The writer has examined Mr. Cole's article, as well as two accounts received directly, one of them not used by Mr. Cole. The two heights, corresponding to 30° and 10° are respectively 32 and 8 miles. The best estimate would be their weighted average, or 18 miles. The azimuth of the plane of motion was from 30° to 210°, probably correct to within 10°.

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1930 January 18.

A Brilliant Fireball.

At the conclusion of a night of observing, I was on my way home when my attention was suddenly arrested by an illumination of surrounding objects as if by a flash of lightning. Looking up, straight ahead of me, I saw the most brilliant and beautiful fireball it has ever been my good fortune to witness. The following are my notes, made as soon as I reached home (about one minute's walk).

DATE: 1930, January 3, 5:50 A.M., E.S.T.
PLACE: Ann Arbor, Michigan, Geddes Avenue near Elm Street (about one-quarter mile south of Detroit Observatory).

OBSERVER: D. B. McLaughlin.

PATH OF FIREBALL: One or two degrees east of β and α Serpentis and γ Librae. First seen between β and α Serpentis, and disappeared behind house a few degrees south of γ Librae.

SPEED: Moderate; estimated at ten or fifteen degrees per second.

BRIGHTNESS: Greatly exceeded full moon and appeared to fluctuate. Landscape illuminated.

COLOR: Brilliant electric blue (like magnesium flare).

TRAIN: Extended nearly from α Serpentis to γ Librae. Color reddish. Ends of train died out quickly, but central portion, five or six degrees in length, persisted for about 30 seconds. This portion seemed to develop a few slight kinks before it disappeared.

OTHER METEORS: During several minutes watching afterwards, three faint meteors with very short paths, approximately parallel to that of the fireball, were seen in the same quarter of the sky. One other faint one moved nearly at right angles to the fireball's path. A little later (6:02 to 6:10) during several minutes no meteors were seen at all.

OTHER OBSERVATIONS: Mr. Andrew J. Hassing, of Detroit, wrote to the observatory to inquire about the meteor after he had failed to find any mention of it in the Detroit papers. He described the phenomena very clearly and stated that the meteor appeared in the southeast "or perhaps more to the south." I shall attempt to get from him a more accurate statement.

NEWS ITEMS: As far as I know at this time the meteor was not recorded in the Detroit papers. Professor A. D. Maxwell of this observatory takes the Sacramento (Calif.) *Bee*. In the January 4 issue of that paper there appeared three items in regard to what was evidently considered to be the same meteor. The first item records the passage of a meteor over Reno, Nevada, at 12:15 A.M. (evidently Pacific Time). This was obviously an entirely different meteor.

The other two items very evidently refer to the meteor seen by me. One from Cleveland (Associated Press) states that the meteor was seen by "hundreds of persons in northern Ohio and western Pennsylvania." An Associated Press item from Chatham, Ontario, records the passage of the meteor, stating that "it disappeared in the west." This last is evidently inaccurate. Had it disappeared *due* west of Chatham it would have passed north of Ann Arbor.

PUBLICITY: An attempt is being made here to give the meteor the publicity it should have received locally immediately after its appearance. It is hoped that names of a number of people who saw it can be secured, and that enough information can be gathered to determine the path it followed. The same should certainly be done in the case of the Reno meteor. It is tempting to suggest that both may have belonged to the same swarm.

DEAN B. MCLAUGHLIN.

Detroit Observatory, Ann Arbor, Michigan.

NOTES FROM AMATEURS

The Lunar Eclipe of November 26-27, 1928.

The total eclipse of the moon on the night of November 26 and the morning of November 27, 1928, was observed here, both telescopically, and with the naked eye. Observing conditions were considered to be fair, no clouds were in the sky, no wind was blowing, and the temperature at the beginning of the observations was 11° C. The telescope employed was a 7-inch reflector of 72 inches focus, magnifications ranged from 40 to 150 diameters. A simple attachment to the telescope provided a means for photographing the eclipse; the focusing of the apparatus was carried out with the aid of ground glass. Since the telescope is not provided with clockwork or slow motions, the exposures for the photographs

must necessarily be one-half second or less. Eastman Lantern Slide plates were used exclusively; the types known as *slow* and *regular* gave about equally good results.

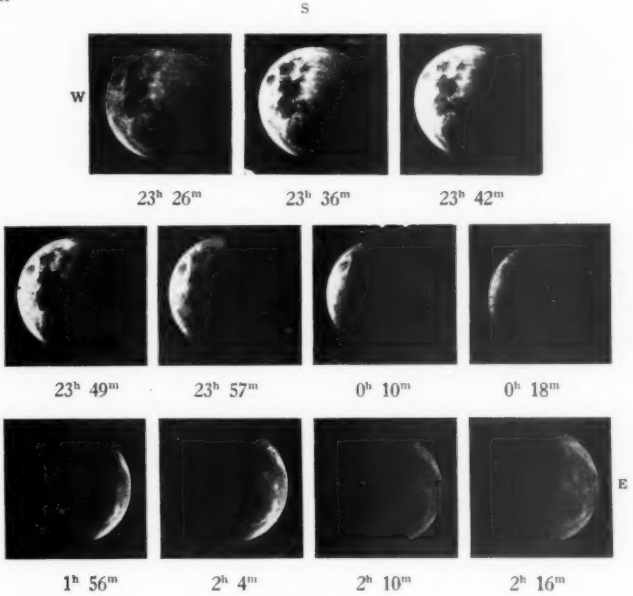


FIGURE 1.
LUNAR ECLIPSE, NOVEMBER 26-27, 1928, AT VARIOUS STAGES.

At approximately 23h 22m, Los Angeles time, November 26, the umbra was observed to touch the lunar disk. The first photograph of the eclipse was obtained at 23h 26m (Figure 1). Photographs were taken at intervals of nine or ten

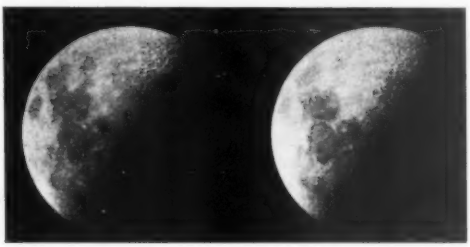


FIGURE 2.
MOON NEAR FIRST QUARTER, NOVEMBER 20, 1928.

minutes, both before and after totality. Cloudiness prevented the securing of a complete photographic record of the eclipse. Figure 2 shows the appearance of an un-eclipsed moon, aged approximately 8½ days; this photograph is included

for the purpose of showing the difference at the terminator of an eclipsed and uneclipsed moon. Most of the eclipse photographs depict the circularity of the earth's shadow; the ending of the shadow is shown by the photographs to be very hard to determine.

Following are a few notes on the naked eye appearance of the eclipse:

Nov. 26 $23^h\,22^m$ Temperature 11° C. The umbra was observed to come in contact with the lunar disk.

Nov. 27 $0^h\,10^m$ Approximately three-fourths of the lunar disk was eclipsed; the remaining illuminated portion appeared orange in color; the lunar seas were scarcely visible.

Nov. 27 $0^h\,30^m$ Only a very small portion of the moon was not eclipsed and this portion was a yellowish-orange color. The eclipsed disk was extremely dark.

Nov. 27 $0^h\,45^m$ Temperature 10° C. The moon was completely immersed in the shadow, although the northwestern portion of the disk remained easily visible, shining with a yellowish-white light. The exact opposite portion of the disk was scarcely visible; the remaining part appeared a deep orange in color.

Nov. 27 $1^h\,27^m$ Temperature 9° C. The major lunar seas were very faintly visible to the naked eye with the moon still totally eclipsed.

Nov. 27 $1^h\,37^m$ The umbra began to leave the lunar disk. The terrestrial atmosphere was becoming cloudy.

Nov. 27 $2^h\,6^m$ The clouds began to disperse; however, a slight haze covered the moon.

Nov. 27 $2^h\,40^m$ The eclipse was not quite over, and the sky clouded over completely.

Well known authorities state that when the moon has a piebald appearance during an eclipse, the terrestrial atmosphere is not saturated homogeneously with water vapor. No doubt, this was the case during this eclipse as it certainly had a mottled appearance. The atmosphere that is concerned with the appearance of the eclipsed moon, however, is that which is near the eastern and western eclipse limits. It would be interesting to learn just what the condition of the atmosphere was in the portion of the earth where the limits for this eclipse occurred.

2318 Tenth Avenue, Los Angeles, California. REGINALD F. BULLER.

COMET NOTES

By G. VAN BIESBROECK.

COMET 1929 *d* (WILK). The information given last month about this comet, which had then just been discovered, was not sufficient for locating it in the western sky in January. It is now passing out of sight for northern observers. Two sets of elements have been published as follows:

	Bower and Whipple (Berkeley)	Banachiewicz (Cracow)
Perihelion-time	1930 Jan. 22.28 U.T.	Jan. 22.257 U.T.
Perihelion to node	157° 20′	157° 8′
Node	158 58 } 1929.0	178 41 } 1929.0
Inclination	124 28	124 31
Perihelion-distance	0.674 astr. units	0.6736 astr. units

The first elements are based on three observations, Dec. 21, 22, and 23, the first two of which are only 0.4 days apart. Yet the result is quite near to the second set computed from observations between Dec. 21 and 25. The rapid apparent motion at the time of discovery was a favorable circumstance in this re-

spect. Banachiewicz notes that there is some similarity between the orbit and that of a comet observed in 1739 by Zanotti at Bologna. The identity is however questionable.

EPHEMERIS FOR 18^h U.T.

	α	δ	log. r	log. Δ	Mag.
	h m s	° ′			
1929 Dec. 28	19 35 18	+26 41	9.925	9.959	7.5
1930 Jan. 5	20 38 1	15 24	.878	0.005	7.5
13	21 19 45	+ 5 18	.843	0.068	7.6
21	47 33	— 3 2	.829	0.129	7.8
29	22 6 55	— 9 53	9.840	0.180	8.1

The above short ephemeris, deduced by Crommelin from the second set of elements, shows that in its rapid southerly motion the comet will be lost in the sun's rays at the end of January. The inclination is high and the motion retrograde. The maximum brightness of 7^M was reached shortly after the discovery so that naked eye visibility was not reached. Not until April will the comet emerge sufficiently from the vicinity of the sun so as to be again observable but it will then be in reach of southern observers only and it will have lost much of its brightness.

COMET 1929 *d* (WILK).
Enlarged 1½ times from a 30-min. exposure by G. Van Biesbroeck, 1929 Dec. 31.

The day after the discovery several observers recorded the presence of a faint tail emerging from the round coma in a northerly direction which was then opposite to that of the sun. The short exposure obtained here on December 22 and reproduced last month on p. 61 showed the tail clearly over a length of 20′ although it was suspected to extend farther. On the plate obtained December 31, reproduced here in a 1½-fold enlargement, the tail is shown up to the edge of the plate 1°.6 from the nucleus and evidently it extends beyond that point. All the tail material streams out of the coma through a very narrow neck for the first 3′ or 4′ but it soon spreads into a bundle of fine filaments in the space between position-angle 12° and 20°. These threadlike streamers extend to about 45′ from the nucleus but there is a stronger central one which proceeds very much farther. It shows a slight bend eastward at 30′ from the nucleus, after which the original position angle of 16° is resumed. One degree from the nucleus there is a marked condensation of material and at that point the tail becomes decidedly wider and more diffuse. On January 22 the tail, projected in the direction opposite to that of the sun, was lagging 5° or 6° behind the radius vector. On that evening the angular separation from the sun was only 30° so that only short exposures were possible. The total brightness at that time was estimated as be-

ing equivalent to that of a $7^{M}.5$ star, but that figure is uncertain on account of low altitude.

Aside from Comet Wilk two very faint comets are kept under observation with larger instruments. The first one is Comet 1927 *d* (Stearns) about which we have reported month after month for nearly three years. The following ephemeris, which is a continuation of the one given on p. 347 (vol. 37) has been computed by the writer in order to enable a further watch.

Ephemeris Comet 1927 IV (Stearns).

0^{h} U.T. 1930	α h m s	δ ° ′	log. Δ	Mag.
Jan. 8	21 15 23	+62 7.6	0.9501	16.0
16	21 24 13	61 45.9		
24	21 33 3	61 29.6		
Feb. 1	21 41 53	61 11.8	0.9645	16.1
9	21 50 36	61 11.9		
17	21 59 12	61 10.5		
25	22 7 39	61 13.8	0.9782	16.2
Mar. 5	22 15 54	61 21.8		
13	22 23 53	61 34.0		
21	22 31 34	61 50.2	0.9900	16.3
29	22 38 56	62 9.9		
Apr. 6	22 45 55	62 33.0		
14	22 52 31	62 59.1	0.9992	16.4
22	22 58 40	63 27.7		
30	23 4 17	63 58.5		
May 8	23 9 19	64 31.4	1.0055	16.5
16	23 13 48	65 5.2		
24	23 17 30	65 40.2		
June 1	23 20 30	66 15.6	1.0089	16.5
9	23 22 39	66 51.0		
17	23 23 55	67 25.4		
25	23 24 18	67 59.0	1.0099	16.5
July 3	23 23 39	68 30.0		
11	23 22 0	68 58.4		
19	23 19 19	69 23.2	1.0089	16.6
27	23 15 42	69 44.4		
Aug. 4	23 11 9	70 0.2		
12	23 5 49	70 10.4	1.0073	16.6
20	22 59 57	70 14.2		
28	22 53 41	70 11.3		
Sept. 5	22 47 20	70 1.3	1.0062	16.6
13	22 41 7	69 44.6		
21	22 35 20	69 20.9		
29	22 30 9	68 51.2	1.0080	16.7
Oct. 7	22 25 47	68 15.5		
15	22 22 19	67 35.5		
23	22 19 62	66 51.4	1.0108	16.7
31	22 18 14	66 4.7		
Nov. 8	22 17 40	65 16.0		
16	22 18 0	64 26.7	1.0182	16.8
24	22 19 10	63 37.7		
Dec. 2	22 21 8	62 49.8		
10	22 23 47	62 3.7	1.0289	16.8
18	22 27 1	61 20.4		
26	22 30 51	+60 40.1		

On January 1, I found the small correction —7ˢ and —0.2 and estimated the magnitude as 16, which figure was adopted for computing the slowly decreasing brightness for the balance of the year.

The second faint comet that has again been observed is 1927 *i* (Schwass-

MANN-WACHMANN) which is now classified as 1925 II. This is the third opposition of this object, which is remarkable by its small eccentricity of 0.14, as illustrated on p. 11 of vol. 36. During its period of 16 years it remains all the time between the orbit of Jupiter and that of Saturn. There is a good chance that this will become the first comet to be followed all the way around its orbit. What adds to the unusual character of this object is the large variation in its brightness. In 1927 it surprised us by a rapid fading after opposition; yet its distance did not vary appreciably and being six astronomical units away from the sun it would hardly be expected to develop any internal physical activity. At this opposition the search was started November 6 by W. Baade at Bergedorf but he could not find the object although stars of magnitude 17 were recorded on his plates. One month later, while the theoretical brightness was hardly different, the comet was readily located by him on December 2 as a small round nebulosity of magnitude 13.5! But it faded rapidly. On December 28 I estimated the magnitude as 15 from an exposure of 40 minutes with the 24-inch reflector; it appeared then as a round nebulosity at least one minute in diameter with a central condensation of about one-third of that diameter. When seen with the 40-inch refractor on December 30 I roughly measured the diameter as 25″ so that evidently only the densest part of the nebulosity photographed two days before made an impression on the eye. The brightness computed from the distance-relations would have changed but a couple of tenths in November and December.

Williams Bay, Wisconsin, January 23, 1930.

GENERAL NOTES

Bernard H. Dawson, of the observatory at La Plata, Argentina, is spending the second semester in graduate study at the University of Michigan.

Dr. Asaph Hall, of the U. S. Naval Observatory, who retired from a professorship of Mathematics in the U. S. Navy on June 30 of last year, died on January 12 in his seventy-first year. (*Science*, January 17, 1930.)

Professor Ralph H. Curtiss, chairman of the department of astronomy and director of the observatories of the University of Michigan, died on December 25, after a brief illness. An account of his life and of his valuable contributions to astronomy will be given in this magazine in the near future.

Professor W. Carl Rufus, who has been connected with the work in astronomy at the University of Michigan since 1913, has been appointed chairman of the department of astronomy and acting director of the University Observatory.

Royal Astronomical Society of Canada, Winnipeg Center, has scheduled a series of nine meetings for the winter season of 1929-30. At the several meetings topics of general interest are discussed by various members of the society. The president for this year is Professor L. A. H. Warren.

The Amateur Astronomers Association, New York City, continued its series of Radio Talks over Station WOR, Saturdays at 5:30 to 5:45 P.M., according to the following schedule: Saturday, January 4, 1930, Mr. David B. Pick-

ering, "The Romance of Variable Stars"; Saturday, January 11, Mr. Stansbury Hagar, "Star Lore and Astronomy of the North American Indian"; Saturday, January 18, Dr. E. E. Free, "Einstein and the Stars"; Saturday, January 25, Dr. Palmer H. Graham, "Comets and Meteors."

Regular evening meeting programs were held also, as usual. January 8, 1930, motion pictures, "Einstein Theory of Relativity," repeated by request; January 22, "Ether Drift and Relativity," Professor Dayton C. Miller.

For February the meetings have been planned as follows: February 5, Dr. Willis I. Milham, Professor of Astronomy, Williams College, "Time and Timekeepers," (illustrated); February 19, Dr. Harlan T. Stetson, of Perkins Observatory, Ohio Wesleyan University, "Eclipse Hunting," (illustrated by motion pictures and slides).

The Radcliffe Observatory.—The buildings and grounds of the Radcliffe Observatory, Oxford, England, are to be sold for the purpose of developing an infirmary and a University Medical School. The work of the Observatory will be continued for a period of five years in order to complete the program of determining the proper motions of some 30,000 stars in the Kapteyn Areas. After that the Radcliffe Observatory will be moved to South Africa. Dr. W. H. Steavenson is now in South Africa making an exploratory survey for the purpose of finding the place most suitable for the relocation of the Observatory.

Astronomical Personnel Exchange.—A notice recently received from Professor R. S. Dugan, Secretary of the American Astronomical Society, states that with the approval of the Council of the A.A.S. he is undertaking to maintain on file whatever information is available relating to vacancies seeking workers, and workers seeking positions. Such a clearing house, it is believed, will be found exceedingly serviceable. It will enable a position and a candidate, who may be separated by some thousands of miles, to find each other more readily. Professor Dugan's address is Princeton University Observatory, Princeton, New Jersey.

The 60-inch Reflecting Telescope for Harvard College Observatory is now completed and has been accepted as satisfactory with favorable comments from many quarters, both verbal and written. It is soon to be dismantled and will be re-erected in Bloemfontein, South Africa, for further study of the skies of the Southern Hemisphere. This is the largest telescope thus far manufactured at the Fecker plant, others ranging from three-quarter inch upward.

The 70-inch disc cast by the Bureau of Standards for Ohio Wesleyan University is in the process of having the second surface ground. It has cleaned up to 69 inches and bids fair to making a very successful mirror.

Scientific Book Club. — In keeping with the growing interest of the reading public in the developments in science, a club as named above has recently been formed, whose purpose is to guide its members in the selection of its reading material in the scientific field. The editorial committee, composed of Kirtley F. Mather, Arthur H. Compton, Edwin G. Conklin, Harlan T. Stetson, Edward L. Thorndike, all well recognized names in the various sciences, inspires confidence. In addition there is an advisory board of eleven, among whom are the most outstanding of American scientists. The plan is to select one book a month and the members of the club are expected to purchase at least six books in a year. The books recommended will cover nearly every branch of science, including

astronomy, psychology, anthropology, physics, biology, chemistry, geology, and sociology. The first book selected for the Club is "The Master of Destiny" by Professor Frederick Tilney.

Science Prize.— The largest single monetary award in America for scientific accomplishment has been created by *Popular Science Monthly*, which, beginning this autumn, will confer an annual prize of $10,000, accompanied by a gold medal, upon the American citizen who has been responsible, during the preceding year, for the achievement in science of greatest potential value to the world.

The prize will be conferred for the first time in September, 1930, and the initial period of scientific accomplishment to be considered by the Committee of Award will be the twelve months ending June 30, 1930. All scientific workers, professional and amateur, academic and commercial, are eligible.

Summary of Sun-Spot Observations at Mount Holyoke College, 1929.

		North of Equator		South of Equator			
Month	No. of Obs.	No. of Groups	Av. Lat.	No. of Groups	Av. Lat.	Av. No. at one Obs.	New Groups
January	15	9	+10°8	7	— 9°5	4.60	16
February	15	6	8.6	13	10.0	4.40	15
March	15	5	11.6	9	7.9	3.20	12
April	15	10	10.1	13	9.6	3.07	23
May	20	14	13.7	8	8.3	4.75	18
June	9	8	12.1	9	12.4	4.57	15
October	21	19	12.9	11	14.5	2.87	30
November	20	22	11.2	8	9.4	4.95	30
December	14	19	+12.7	8	— 9.4	5.13	22
	144	112		86			181
Average number at one observation						4.21	
Average latitude of groups north of equator						+11°7	
Average latitude of groups south of equator						—10°4	

No spots were seen on October 20, 21, 23.

Positions for the month of October are less accurate than those for other months as our frame for observing was temporarily out of commission.

Most of the observations from January through June were made by Miss Laura Ewalt and Miss Catherine Stillman; from October through December they were made by Miss Helen Porter.

ANNE S. YOUNG.

John Payson Williston Observatory.

The Eclipse of 1930 April 28.

Observers on the central line of this eclipse would do well to note that the occasion affords an unusually good opportunity for observing the lower corona before and after totality. In most eclipses the excess of the moon's semi-diameter over that of the sun is so great that very little of the lower corona is exposed before second or after third contact. But in the case of a short totality the conditions are much more favorable. On the occasion of the eclipse of 1927 June 29, I was able to see the brighter parts of the lower corona for as much as three minutes after the end of the total phase. This was with a three-inch telescope and a power of 18. The sun was low and the sky very far from transparent. With a high sun and smaller moon, as in this year's eclipse, it should be possible to keep the corona in sight for a considerably longer time. It is, of course, essential that the unobscured solar crescent should be kept just outside the field of

view, not only because of its dazzling effect upon the eye, but also because the observer might otherwise be biassed by knowing just where to look for the moon's dark limb. Such bias is probably at the bottom of many reported observations of the dark side of Venus. I should recommend a somewhat higher power than the one I used (six to the inch of aperture), in order to reduce the apparent brightness of the field. Ten or fifteen to the inch would probably give more satisfactory results.

W. H. Steavenson.

London, 1930 January 2.

Zodiacal Light Notes.

Fluctuations.—Under date of December 13, 1929, Professor I. Yamamoto, Imperial University, Kyoto, Japan, writes: "A singular experience was obtained by two of our observers recently. It was in the early morning of November 3 when Mr. Kamei, at Kyusyu in the west of the Empire, and Mr. Araki, near Okayama City by the Inland Sea, saw simultaneously a remarkable change of the Zodiacal Light within a few minutes. They are experienced observers and both living in the country, some 200 miles apart, so that they are certainly not influenced by any artificial or terrestrial disturbances. At present we are investigating the nature of these rapid changes in the Zodiacal Light." From the record kept at Cheltenham, Maryland, it appears that on November 3 a magnetic storm of strong intensity was noted. The coincidence of this disturbance with the fluctuations observed in Japan supports the theory of a possible connection between magnetic storms and Zodiacal Light fluctuations. This theory was discussed by Dr. E. O. Hulburt, Naval Research Laboratory, at the recent meeting of the American Physical Society.

Evening Zodiacal Light.—On January 3 from 7:00 to 7:15 the writer observed the Light passing south of the square of Pegasus and reaching an apex south of β Arietis, about 107° from the sun. The moon was three days old, just past apogee and not strong enough to blanket the Light, in fact it added diffused light in the zodiacal zone towards the horizon. During the time of observation the Light was steady. Clear sky. Main body of Light north of the ecliptic.

On January 4 at 7:30 the moon being four days old the Zodiacal Light was still visible though more diffused than on the previous evening. Its boundaries were not well defined but the contrasting relative darkness between the western side of the Square of Pegasus and the Milky Way in Cygnus left no doubt that the diffused light was zodiacal. Had the moon been in the perigee part of its orbit it is likely that no trace of the Zodical Light could have been detected. At 8:50, the moon then being about 5° from the horizon and the sky much darker than at 7:30, the Zodiacal Light was traced almost to the Pleiades.

Moon Zodiacal Light.—On December 21, moon twenty days old, moonrise 10:52, the writer scanned the eastern sky in Leo. As he watched at 10:30 he saw a faint illumination shaped liked blunt-nosed cone extending almost to Regulus. At 10:40 the cone became elongated and reached almost to Praesepe where it remained until moonrise. Though extremely faint, the apparition was unmistakable. The best time to observe the moon Zodiacal Light is two or three days after opposition. When the moon is nearing the third quarter the illumination is proportionately faint and difficult to see. On this evening seeing conditions were excellent.

W. E. Glanville.

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